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THE

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AN ILLUSTRATED MONTHLY

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THE NATIONAL GEOGRAPHIC MAGAZINE

WILD MAN AND WILD BEAST IN AFRICA

BY THEODORE ROOSEVELT

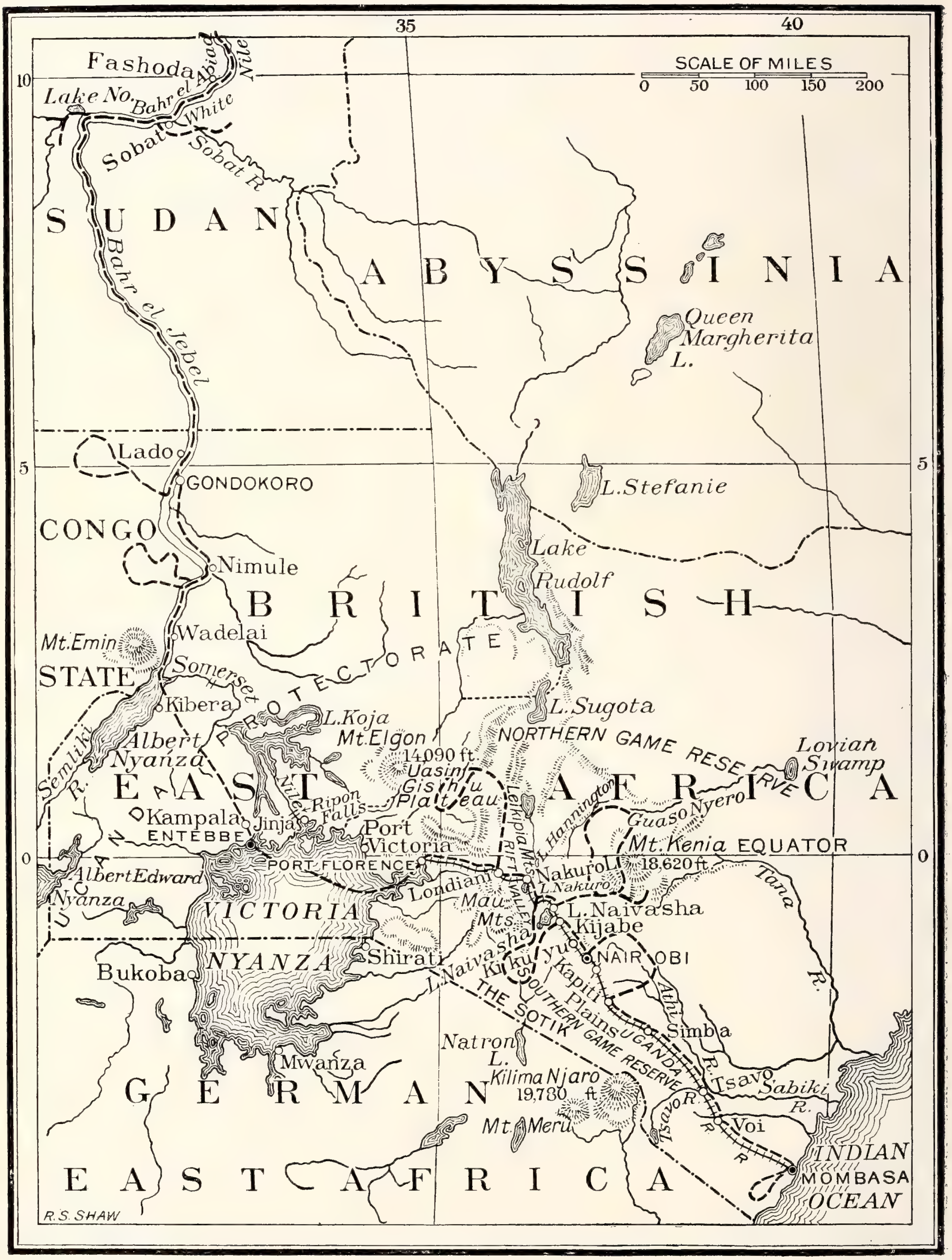
HONORARY MEMBER OF THE NATIONAL GEOGRAPHIC SOCIETY

The following article is the address delivered before the National Geographic Society by ex-President Roosevelt, November 18. In presenting Mr. Roosevelt, President Gannett read the following resolution, which had been unanimously adopted by the Board of Managers of the National Geographic Society:

"RESOLVED, *That the National Geographic Society through its Board of Managers herewith tenders to Theodore Roosevelt its hearty appreciation of his services to geographic science, both for his own work in that field as illustrated by his books, 'The Winning of the West' and 'African Game Trails,' and by the results of his expedition to tropical Africa, which brought back unparalleled zoological collections, and for his interest in the furtherance of original geographic works during his administration as President of the United States. Among these may be mentioned his success in obtaining an equitable decision relative to the Alaskan boundary; the aid he extended to Peary, which resulted in his discovery of the North Pole; his work for the Panama Canal; his interest in the irrigation of our arid lands and in the right using of our forests; the preservation of birds by the establishment of bird reservations; the measures taken by him to protect our natural wonders by reserving them as national monuments, and his active assistance in other problems in which the student of geographic history is most deeply concerned.*

"For all these things the National Geographic Society holds Theodore Roosevelt in the highest honor."

IT is a very real pleasure to be here this evening, and no pressure was necessary to get me to come. I had always wished to have the chance of speaking first under the auspices of this Society when I came back from the other side to give an account of my stewardship. Before speaking about my trip itself, I want to say a word or two as to the circumstances under which I took it. I have always felt a little bit as if I was entitled to praise from the National Geographic Society only because I was interested in other branches of science, for I never really did anything for geography at all. But I have been so much interested in sciences connected with geography—in sciences which can be studied in company with those actively interested in geographic



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MAP SHOWING MR. ROOSEVELT'S ROUTE AND HUNTING TRIPS IN AFRICA

This map and the following illustrations, published by special permission of Charles Scribner's Sons, are from "African Game Trails: An Account of the African Wanderings of an American Hunter-Naturalist," by Theodore Roosevelt, and from other photographs by members of the expedition.

Photo by Heller. Copyright by Charles Scribner's Sons

CARRYING HEAD SKIN OF MERU BULL ELEPHANT TO CAMP

It required 20 men to carry each elephant's skull

science—that I have had the keenest possible interest in what has been done by this Society.

My going to Africa as the head of a scientific expedition was first suggested to me by Dr. C. Hart Merriam. I then got into communication with one or two gentlemen connected with the scientific work here in Washington, and they communicated with the Secretary of the Smithsonian, Mr. Walcott, who was then away from Washington. He instantly wired me his cordial approval of the suggestion, and said he hoped that I would make the trip for the Smithsonian Institution, and it was under Mr. Walcott, with Mr. Walcott as my superior officer, that I made my trip in Africa.

The success of the trip from a scientific standpoint depended upon the character of the scientific men we had with us. It would be quite impossible to overstate the value of the services rendered by Dr. Mearns, Mr. Heller, and Mr. Loring. I doubt whether three men better equipped for their work and more zealous in doing their work ever went on such an expedition, and the labor fell entirely on them. Really, I would be ashamed of myself sometimes, for I felt as if I had all the fun, I would kill the rhinoceros or whatever it was, and then they would go out and do the solid, hard work of preparing it. They would spend a day or two preserving the specimen, while I would go and get something else. At times I felt that it was a most unequal division of labor—that I was having the enjoyment, while the work of bringing practical results was being done by them, and it was being done by them not merely faithfully, but as a labor of love. They did it so well because they would rather have done it than to have done anything else at all; they would rather have had that opportunity than to have had any other opportunity that the world that year gave, and naturally there was a

Photo by J. Alden Loring. Copyright by Charles Scribner's Sons

TOWING BULL HIPPO ASHORE: LAKE NAVAISHA

particular pleasure in working with men who approached their work in such a spirit.

I should also, in fairness, mention another member of the Roosevelt family, my son Kermit, who did some excellent photographic work. Indeed, all the members of the expedition except myself did good photographic work. Among the photographs we brought back there were the best photographs of wild elephants that have ever been taken, and the only photographs of living white rhinoceros that have ever been taken.*

Messrs. Newland and Tarlton, of Nairobi, fitted out the expedition, and did this work excellently, and no better guides and managers for such an expedition could have been found in all Africa than Messrs. Cuninghame and Tarlton, the former of whom was with us throughout the trip, and the latter while we were in East Africa.

I, of course, felt that I was bound to make a success of the trip, because in a certain sense my companions and myself were representing the United States. I think I can say that no other expedition of the kind has ever come back from Africa or Asia with a better collection of specimens than we brought back, the collection being especially good in the large game animals. The series of skins, and in many cases of skeletons, of the square-mouthed rhinoceros, reticulated giraffe, giant eland, bongo, northern sable antelope, white-withered lechwe antelope, and Vaughn's kob, for instance, are unrivaled in any European museum. We brought back, I think, all told, some 14,000 specimens of mammals, birds, reptiles, fishes, etc.

Let me repeat, that I cannot overemphasize the part my companions played in the expedition. The chief value of the expedition came not from what I shot, but from what the naturalists, under the direction of Mr. Walcott, who were with me, did in preserving and collecting specimens. It is not a very hard thing to go off into the wilder-

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* Several of Mr. Kermit Roosevelt's photographs of wild elephant and white rhino were published in the November number of this Magazine, through the courtesy of Charles Scribner's Sons.

Photo by J. Alden Loring. Copyright by Charles Scribner's Sons

BULL HIPPO HAULED ASHORE AND READY FOR SKINNING: LAKE NAVAISHA

ness and kill an elephant, or a white rhino, or a reticulated giraffe, or giant eland; but it is a very hard thing to get good photographs of them, and a still harder thing to cure and transport the skins and skulls of a number of such specimens. I can give you, perhaps, an idea of the amount of work done when I mention that we used on the trip ten tons of salt (all at times carried by native porters) in order to cure the skins; that when we killed elephants, for instance, we would have to use 20 men to carry each elephant's skull.

In going down the While Nile, for instance, the river is so broken by rapids that we could not use a boat from Nimule to Gondokoro, and for the ten days' march between those two places our expedition included 450 men, for all the skins and skeletons had to be transported on porters' backs. There were no camels or other beasts of burden; men live with difficulty there, and beasts of burden not at all, so everything had to be carried on the backs of porters. It was no small task providing for the feeding of the porters throughout the journey.

The work was throughout most interesting; but it represents much genuine toil and many difficulties overcome, and we could not have done it at all if it had not been for the hearty way in which the representatives of the Smithsonian and their friends backed us up, financially and otherwise. A hunting trip by itself is simple enough, but a trip of the kind we took is one that entails much forethought, a great deal of expense, and a literally incredible quantity of labor. So much by way of introduction.

I wish that I had a map of Africa here. You are all familiar with the shape of the continent, the northern part being a broad expanse practically filled with one vast desert stretching from the Atlantic across the whole continent to the Red Sea. This desert is broken at only one point, where the Nile runs from the south northward, making a little strip from a quarter of a mile to a couple of miles broad, on which there is cultivation, and where there can be an abun-

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

SKINNING THE HIPPO

dant life. South of the desert region lies Africa proper—the Africa of zoologists, the recently unknown Africa, the Africa that has become open to white explorers, merchants, missionaries, and scientists only within the last half century. Our expedition landed on the east coast of Africa a little south of the equator, went right across the belt of fever-haunted lowland, the fever-haunted coast region, on to the high, broad, healthful uplands of equatorial East Africa, crossed it, went to the great central lakes of Africa, the great Nyanza lakes—Victoria Nyanza and Albert Nyanza—and then went down the Nile, traveling from south almost due north, and came out at Khartum, in the Sudan.

There were no real hardships connected with the trip. There is, of course, a mild amount of danger in chasing the wild beasts, and there is a good deal more danger from disease; but we were fortunate enough not to lose a single white man on the expedition. We had casualties to two of our native attendants from wild beasts. One man was mauled by a leopard and one man was tossed by a rhino. A very few died from dysentery and fever, because it is almost impossible to make them take care of themselves. For instance, we could always get the white men to boil their water before drinking, but we could not make our porters do this. They looked upon it as a superstition upon our part—as one of the queer vagaries of the white people, the strangers from over the seas, which had no foundation in reason. Personally, I grew to be really very much attached to our attendants. They were like great big children. They live a perfectly grasshopper life, with no capacity to think of the future. For

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

PREPARING THE SKIN FOR SHIPMENT

instance, when I was off by myself, with a small safari of from 30 to 40 porters, if there was a rain threatening and we had a long march, I would have to threaten personal violence, and sometimes resort to it, in order to make the porters put up shelters for themselves before the rain came. I had to watch over them just exactly as if they were so many children. I was glad to do it, and our personal followers took the utmost care of us in return and usually showed a desire to look after our welfare that was really touching.

We did not stay on the coast belt for more than a very short time. Dr. Mearns made a short scientific trip there, and my son made another trip after a species of sable antelope which proved to be new. But it is a very unhealthy country, and we did not want to keep the expedition, as such, there any longer than we could help. The highland region, where we spent half of our time while in Africa, is a region of country that in its external features resembles not the Africa of the geographic books, but part of our own West. Most of the higher land of British East Africa, in the regions where we were, reminded me rather of the eastern portions of Wyoming and Colorado, and of parts of New Mexico and Arizona, than of what we are accustomed to think of as the tropics. Of course, there was an infinite difference in detail, but the general effect was the same. It was a region of light rainfall, and that rainfall came in the shape of a violent rainy season, so that there were periods when the rivers would run as boiling torrents, and then long periods when the rivers would be totally dry or consist merely of strings of shallow pools. Over most of the plains there were scattered thorn

Photo by Heller. Copyright by Charles Scribner's Sons

KERMIT'S BUFFALO HEADS ARE BROUGHT IN

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

TURNING THE CARCASS OF THE MERU BULL ELEPHANT

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

OUR TWO MASAI GUIDES IN FROM THE SOTIK TO NAVAISHA

trees and huge euphobias. Elsewhere they were mere seas of withered grass. Out of these barren plains rise great mountains, right under the equator, with snow-peaks.

I was camped under Mount Kenia, directly on the equator, a little over a year ago, when I received news that the Pole had been discovered by an American. My judgment about the first American who asserted that he had discovered the Pole I am happy to say coin-

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

TWO N'JIEMPSI CATTLE HERDS: THE SMALL BOYS ALL CARRY SPEARS: NEAR BARINGO

cided with that of the National Geographic Society. I was camped on the foothills of Mount Kenia when a special message was sent up by relays of runners to tell me that the Pole had been discovered. But they named the wrong man; and, as I had heard something of his alleged mountaineering exploits in Alaska, I declined to send back a message of congratulation. But about a week afterwards I got another message, telling me that Peary had discovered the Pole, and I said, "That is genuine. I will bank on Peary." So I sent out my message of congratulation; and I told the people who were with me then to watch and they would find that the National Geographic Society would look into that business and declare for Peary. I was rarely more pleased than when I found that that was just what the Society had done. For that reason alone I should certainly have come here to make my first report upon the expedition.

I spent several months in this East African region, going north, where the table-land sank lower and lower until we got to the dry, hot desert country of the Guaso Nyero, an equatorial river. Then we went across Victoria Nyanza into the low-lying very fertile and very unhealthy central African region, Uganda. In East Africa the natives were pure savages, ranging from the mere hunter-tribe type, the so-called 'Ndorobo of the mountain forests, to pastoral and agricultural tribes who live out in the plains or on the forest border. There were wide differences among these tribes, some of them very significant.

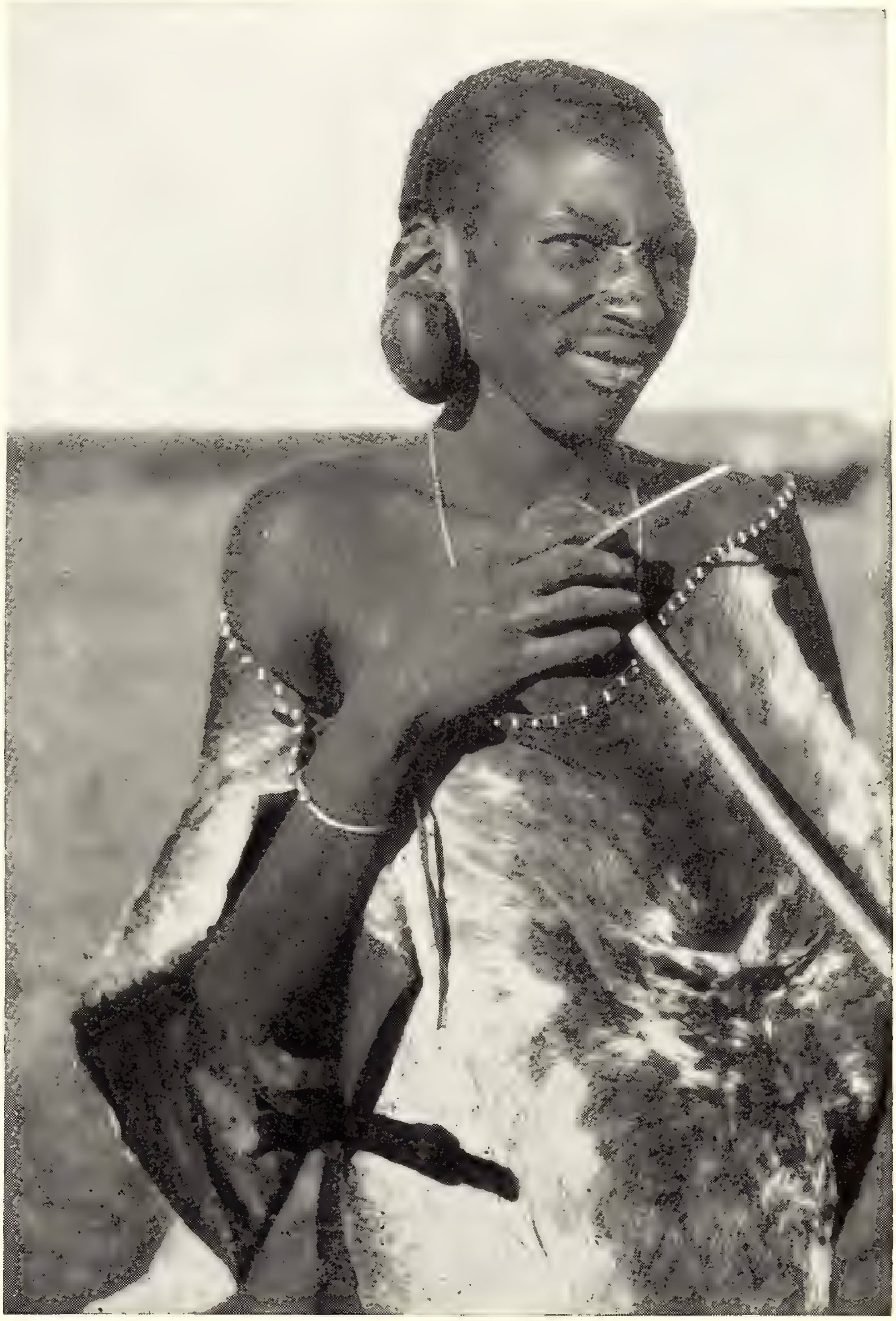


Photo by J. Alden Loring. Copyright by Charles Scribner's Sons

MASAI WITH A STRETCHING STONE IN HIS EAR

The purely negro tribes, the tribes of pronounced negro type, throughout East Africa, were for the most part agriculturalists. Whenever we came upon a region where the people lived in beehive huts and tilled the ground, we were certain to find a nearly pure negro type; but there has been all through that country for ages an infiltration of northern races. I cannot speak of these races with ethnic exactness, because no one can; and the linguistic and racial types often fail to correspond. But you will understand what I mean when I say that they are of dark Arab type, being either black or a very dark brown or yellow, but of the northern type of features. These races have come down from the north and have mixed with the negro type — with the negro aboriginals. But the mixed race has kept some curious points of unlikeness to the surrounding natives. Wherever you meet a pastoral tribe you will find men many of whom show traces of this northern origin—many of whom have clear-cut, aquiline features; and those men you never find living in beehive huts. They live in queer square huts placed in a ring, making what we would call in the West a big corral—a big ring fence in which their cattle are kept. The pastoral tribes which we met north of the Guaso Nyero had camels, and north of these are tribes which own horses. But the Nandi, Masai, and other tribes south of them have neither camels nor horses; they own large herds of cattle, with donkeys, goats, and hairy sheep. They do not till the soil; they live exclusively on meat, blood, and milk. I hate to shock the vegetarians, but I am bound to say that those people, who never eat anything but meat, blood, and milk, are as hearty and strong a set of people as I have ever seen in my life. Many of the Masai and Nandi are particularly fine looking.

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

PORTERS CARRYING PELVIS OF FIRST ELEPHANT

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

SULUMANI, MY TENT BOY, AND CUNINGHAME'S RECORD ROBERTSI

I shall always keep in my mind the memory of one evening when I had killed a lioness. The porters with me were, as they always are, very much excited over the killing of a lion, for the lions are often man-eaters, and kill many of the natives, so that the natives like to reciprocate and see the lions killed. I had killed this lioness quite late in the evening, and the men asked permission to carry it in whole to camp. I did not think they could do it, but I let them try. They started carrying the lioness in relays. It was a very heavy load. After a while they found that it was heavier than they had thought. We were about ten miles from camp, and we had gone only about a mile when

Photo by Cuninghame. Copyright by Charles Scribner's Sons

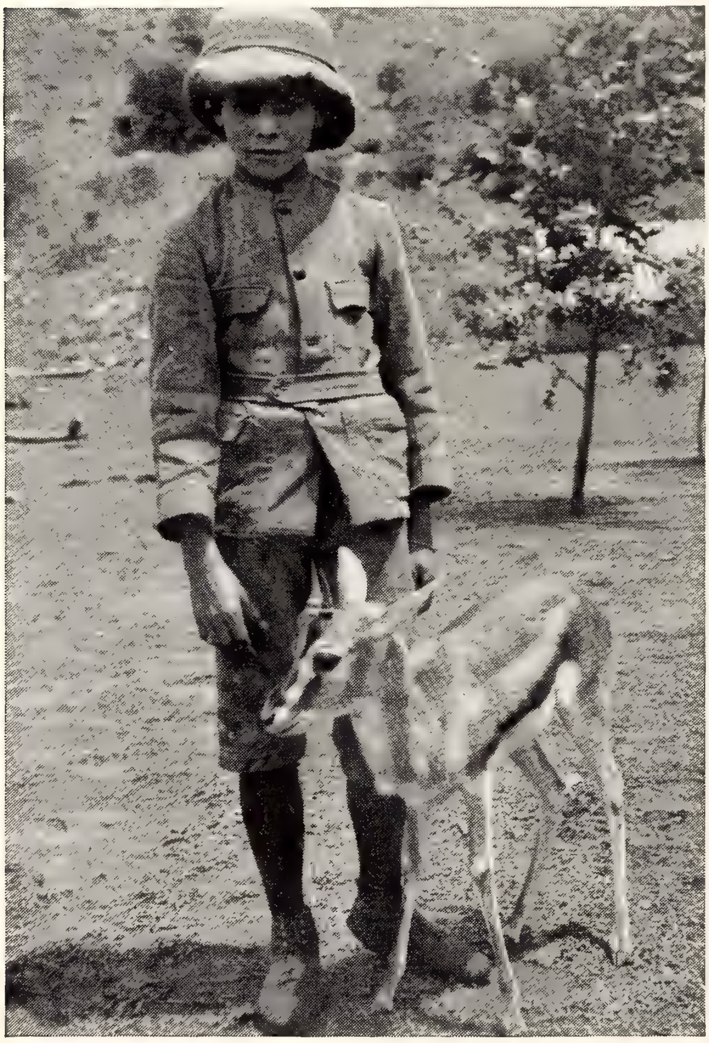
THE HUMPBACKED CATTLE IN THE MASAI COUNTRY

darkness set in. There was an element of interest in going through that part of Africa at night, because then all the wild beasts were abroad. On the occasion in question we were accompanied on one side by a lion for one-half an hour. I do not think he could quite make us out. He could smell the dead lioness and he also smelt us; but I do not think he knew quite what had happened; and so he walked alongside us for a couple of miles, moaning or yawning as he went. Of course we had to keep a lookout for him. I had another white man with me, and either he would go ahead and I behind, or vice versa, so as to keep the porters closed up; because, in a case like that, if a lion does attack a party of travelers, he is most likely to seize the one behind. We still had the lion on one side of us when suddenly on the other side there was a succession of snorts like a steam-engine blowing off steam. It was a rhinoceros, I think two rhinoceroses, up on that side.

While a rhinoceros's short suit is brains, his long suit is courage, and he is a particularly exasperating creature to deal with, because he has not sense enough to know that you can harm him, and he has enough bad temper to want to harm you, so that there is often no way of keeping rid of him except by killing him. Of course we did not want to kill anything we could help—anything we did not use—and we still more strongly objected to being killed ourselves. It was almost pitch dark and there was no moon, although there was star-light. We would hear this rhinoceros snort, and then we would run forward and kneel down or lay down on the ground and try to catch the loom of the rhinoceros against the sky-line, so that we would have a chance to shoot him if he came on. I sometimes had to adjure the porters—I use a mild word when I say "adjure"—in order that they might not break and scatter, when one or more would probably have been

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

FLAMINGOES ON LAKE HANNINGTON, CALLED BY THE NATIVES Z'WA ONDAGE: "THE LAKE OF THE BIRDS"



Settler's small boy with pet "Tommy" gazelle. Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

killed. Finally we left both the lion and the rhino and came to a Masai corral, which was about three miles from our camp. The men carrying the lioness were very tired and I thought it best to stop and skin her. So we called to the people inside of the corral to let us come inside and skin the lioness. At night the cattle are put in the middle of those corrals—those big fenced inclosures with square huts around the edge. The Masai replied that we could not come in, because the smell of the lioness would make the cattle stampede. I think they were a little suspicious of us. My companion offered to give them his rifle to hold as a proof of our good intentions; but they said no; that they didn't want that. They handed us torches; we started a fire. They finally became convinced that we were peaceable, and then they came out to witness the skinning. The porters crouched near the blazing fire, and our gun-bearers started to skin the lioness. Tarlton, the Australian who was with me, and I stood behind, holding the bridles of our horses. Masai warriors and girls came out and, forming a circle around the porters, chaffed and jested with them. There was one man,

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

A WART HOG

evidently the wit of the Masai camp, who described how the Swaheli would go out with the white man to hunt lions; how the Swaheli would find the lion, and then the lion would seize him and bite him, whereupon he would cry and call for his mother. Loud laughter greeted this sally, and the gun-bearers retorted with jest about the lions at the expense of the Masai; how the lions would kill the Masai, but how they could not kill the white man, for the white man killed the lions. As the Masai stood there, the fire lighting up their faces, they reminded me strongly of the pictures of the soldiers of Thothmes and Rameses by the Egyptian sculptors. They had the clear-cut features and the hard, resolute countenances that you see indicated in the sculptures on the temples that commemorate the victories of the mighty Egyptian kings over Hittite and Nubian. Those men looked as if they were blood kin to the Egyptian soldiers who 4,000 years ago made the great Egyptian Empire that extended from the upper Nile to the Euphrates.

Another thing about these natives of East Africa: their clothing was very scanty. In one tribe, the Kavirondo, the men and women literally wore nothing. The curious thing was that those people had extremely good manners. They were very courteous and perfectly at ease—at least the chiefs and the gentle folk—but they did not have any clothes—not a stitch.

When we struck Uganda we found an entirely different and a very curious little semi-civilization. Right in the midst of this huge sea of black savagery there had sprung up this island of progress, representing the beginning of a very primitive civilization.

It is very difficult for us to realize how modern our knowledge of mid-Africa is. I can perhaps bring it to your mind by telling you that in 1858 the first successful efforts were begun toward the exploration of mid-Africa and the finding out of the source of the Nile, Speke, Grant, and Baker being the men who made the actual discoveries. That is about half a century ago. Just before

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

STRIPED HYENA CAUGHT BY HELLER

The expedition took hundreds of traps with them with which they obtained thousands of small mammals for the National Museum.

they went on their expeditions a map of mid-Africa was published under the auspices of the Royal Geographic Society in England, and on that map the sources of the Nile were more imperfectly shown than they were shown on the map of the Ptolemies in the year 150. In other words, during 17 centuries the geographic knowledge of Africa had gone slightly backwards. The men of the first half of the nineteenth century—the scientists in England, in France, in Germany, and in Italy of the first half of the nineteenth century — knew less about the geography of middle Africa than the scientists who lived in Antioch and Alexandria and Rome in the first half of the second century. As a whole, during 1,700 years knowledge had gone a little backward as regards that part of Africa.

When those first explorers reached Uganda they found a semi-civilized region where both men and women were well clothed; where they manufactured their own cloth; where they had good ironsmiths, good workers in iron; where they tilled the ground; where they used musical instruments; where they had, curiously enough, joined to a very cruel despotism of the regular African type a system of representative government. It is not possible to tell exactly how that little semi-civilization arose. Probably what happened was, that there came a tribe of northern invaders—men of Hamitic or bastard Semitic blood—who conquered these negro tribes of middle Africa. The invaders were a comparatively light-skinned, pastoral people, with herds of long-horned cattle. Some of the invaders remained almost separate. Others mixed with the negroes, producing a type that is predominantly negro, with a slight strain of the northern invader. It was this mixed type that went upward, and not the relatively pure type of northern invader; and now the pastoral people occupy a distinctly subordi-

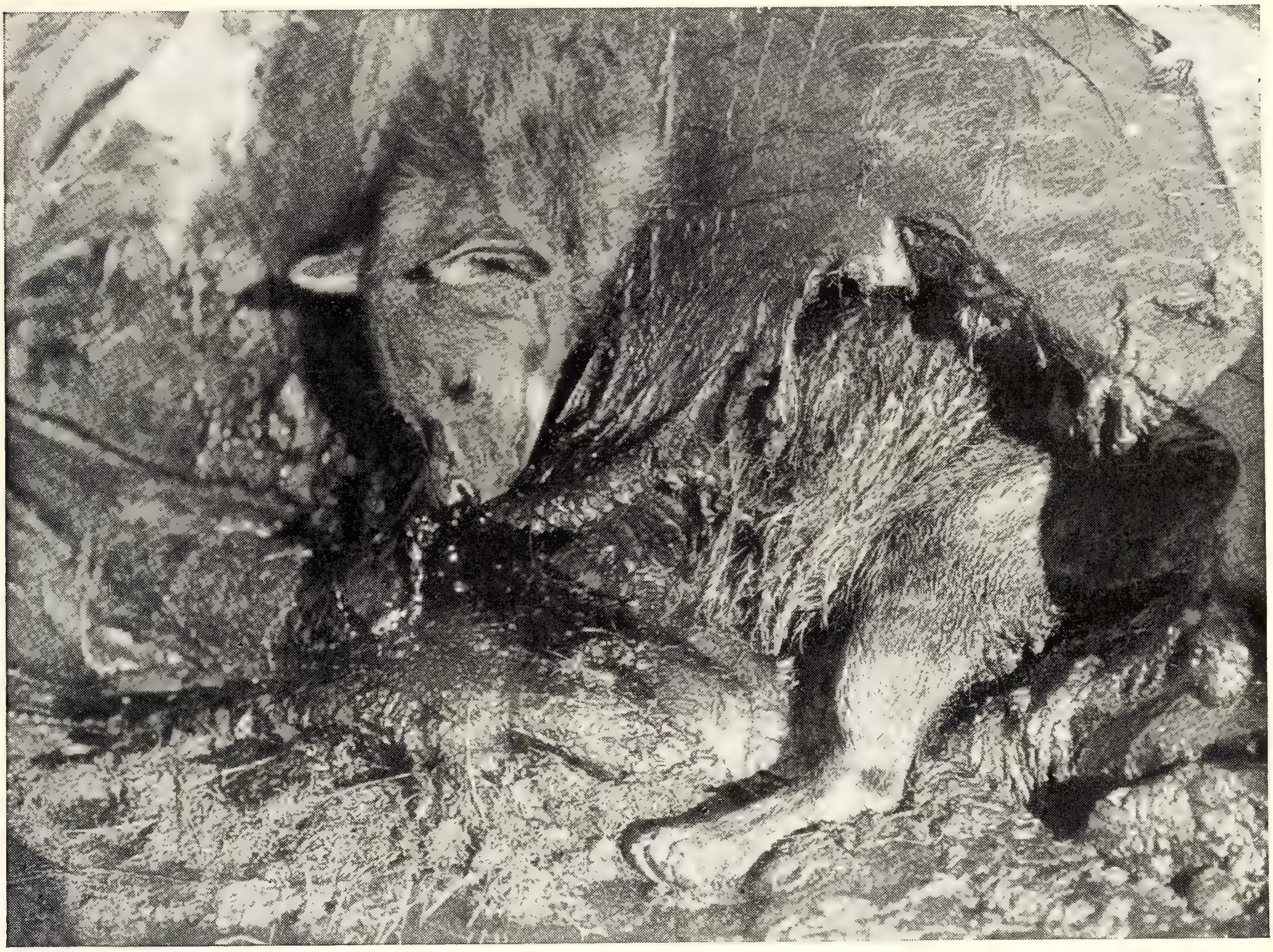


Photo by Akeley. Copyright by Charles Scribner's Sons

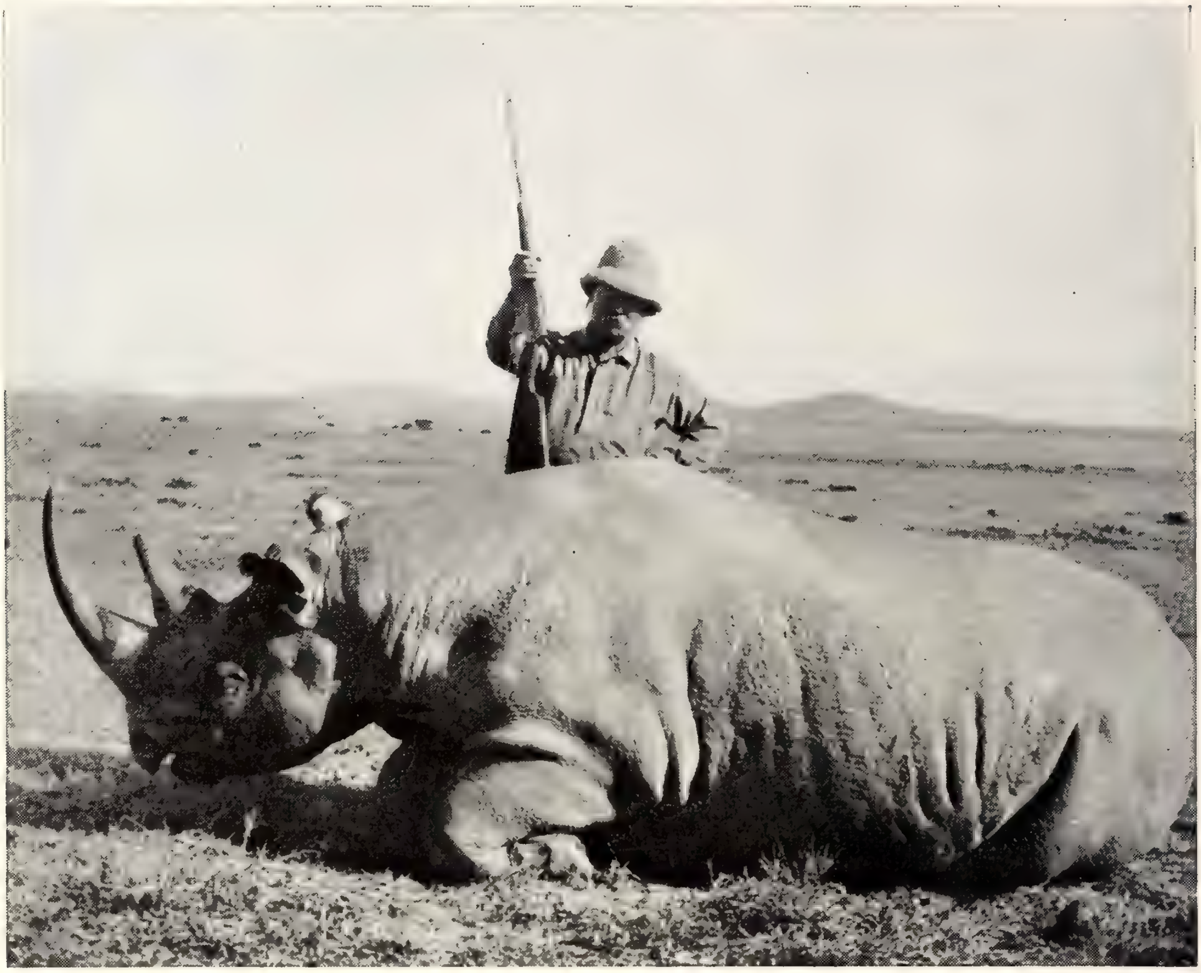
AN UNUSUAL TRAP: A HYENA CAUGHT IN THE BELLY OF A DEAD ELEPHANT

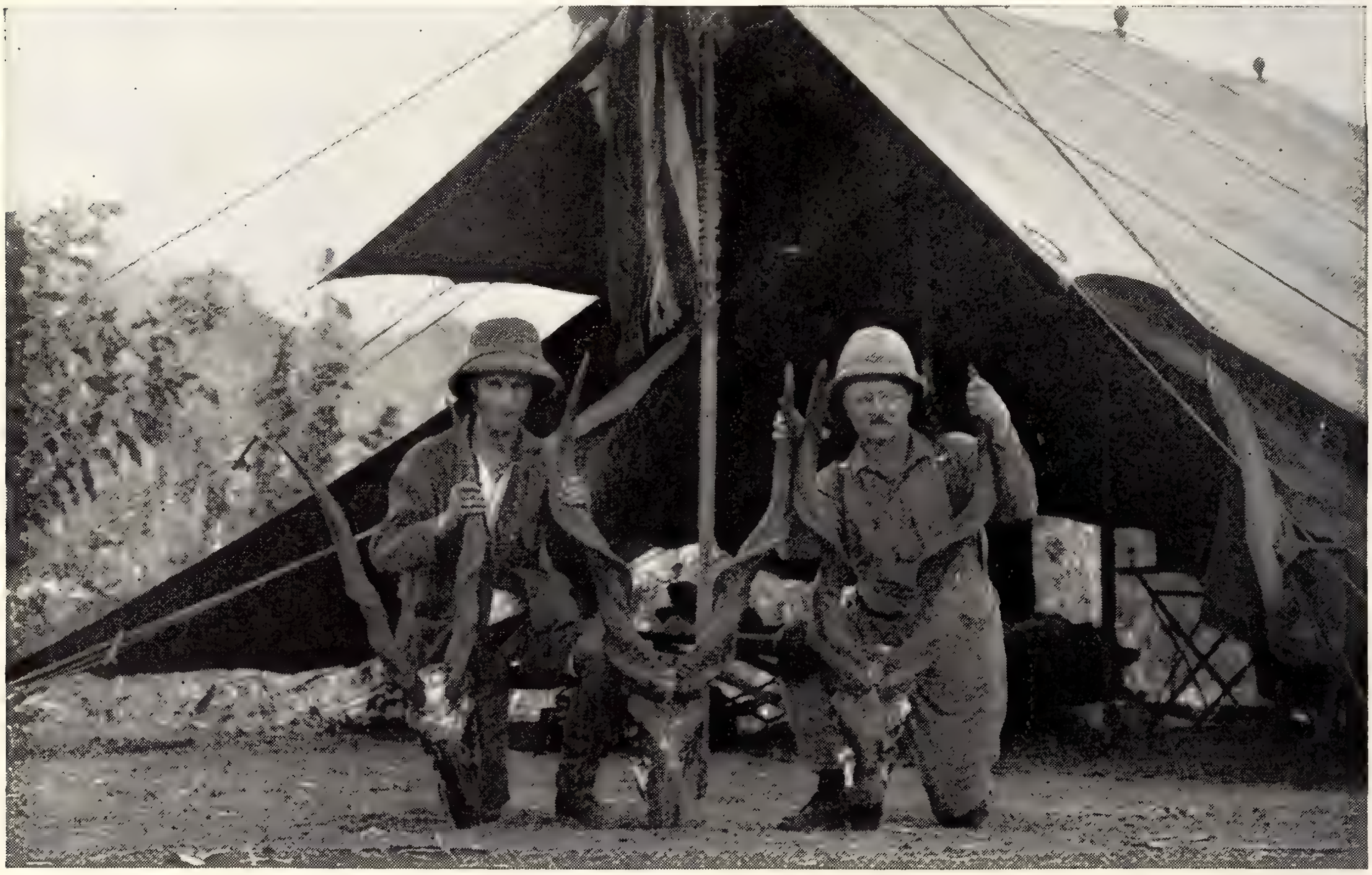
"The hyena, which was swollen with elephant meat, had gotten inside the huge body, and had then bitten a hole through the abdominal wall of tough muscle and thrust his head through. The wedge-shaped head had slipped through the hole all right, but the muscle had then contracted, and the hyena was fairly caught, with its body inside the elephant's belly, and its head thrust out through the hole. We took several photos of the beast in its queer trap."—From "African Game Trails," by Theodore Roosevelt. Charles Scribner's Sons.

nate position to the negroid agricultural people, who form the bulk of the kingdom, and they are very distinctly less advanced in civilization.

The English have been wise in the way they have cared for these people. They have developed them along their own lines, instead of trying to turn them into something entirely different. On the whole the effect of white influence on the native tribes shows to better effect in Uganda than in any other part of Africa south of the Sudan that I saw.

Many of the chiefs are distinctly semi-civilized, and some of them write English well. Two or three have kept up quite a correspondence with me since I left. One of them sent me a gift of four hippopotamus tusks and a leopard's skin, together with a letter of condolence on account of the death of King Edward! This particular chief had done everything he could for me while I was at Lake Albert Nyanza. I had little to give him, as I had exhausted about all my presents. However, I still had a watch with the hands and the figures of the face picked out with radium, so that one could tell the time at night. I gave him this watch, and he and all his companions spent the entire night looking at it. Since then he has been one of the most grateful people I have ever known, and has written me twice. I try to think of





Photos by Kermit Roosevelt. Copyright by Charles Scribner's Sons

MR. ROOSEVELT WITH HIS BIG BULL RHINO

MR. ROOSEVELT AND KERMIT ROOSEVELT WITH GIANT ELAND HORNS

Mr. Roosevelt and his son secured three specimens of this huge antelope for the National Museum; they are the first specimens ever brought out of Africa something in this country sufficiently interesting to him to write him, but it is a hard matter to do so.

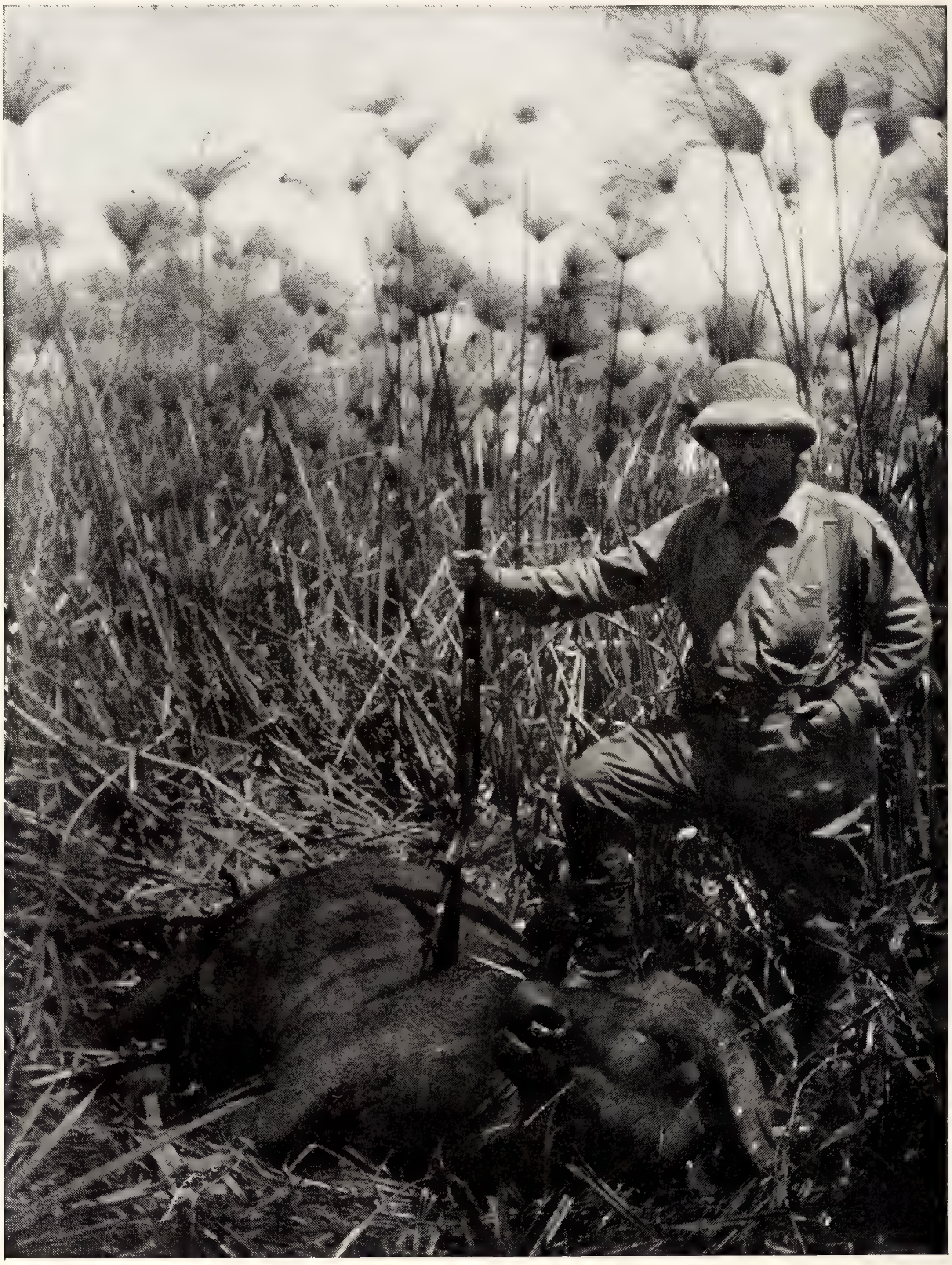
Of course, to a hunter or a naturalist, one of the absorbingly interesting features of the part of Africa that I visited is the enormous and wonderfully variegated fauna. It is literally as if the fauna of the Pleistocene had come to life again. A couple of hundred thousand years ago, or thereabouts—I do not pretend to be accurate in geological time — there was in Europe and here in North America a similar wonderfully varied fauna of great and beautiful and terrible wild beasts. But now we have to go to Africa or to a few places in India to find anything like it. And in Africa where I went the absorbingly interesting thing is that right on top of this Pleistocene has been imposed the twentieth century civilization. A railroad runs from the coast up to Lake Victoria Nyanza, through a country where man is just as primitive as our cave-dwelling ancestors were a hundred thousand years ago, and where men are fighting practically the same beasts as those ancestors of ours fought.

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

THE BUFFALO PATH THROUGH THE PAPYRUS

I really doubt if there is a railroad trip in the world as well worth taking as that railroad trip up to the little British East African capital of Nairobi. The British government has made a great game preserve of part of that country. On the trip from the coast, Governor Jackson, who had very courteously come down to meet me at Mombasa, and the great English hunter Selous and I passed our time on the cowcatcher of the engine, and it was much like going through the garden of Eden with Adam and Eve absent. At one spot we would see suddenly six or eight giraffe going off at their peculiar rocking canter. Then we would see a herd of brightly colored hartebeestes, which would pay no attention to the train at all. Then we would come around a curve and the engineer would have to pull his whistle frantically to get the zebras off the track. The last of the herd would kick and buck and gallop off 50 yards and turn around and again look at the train. Then we would see a rhinoceros off to one side; and so on indefinitely.

Nairobi itself is a town of perhaps



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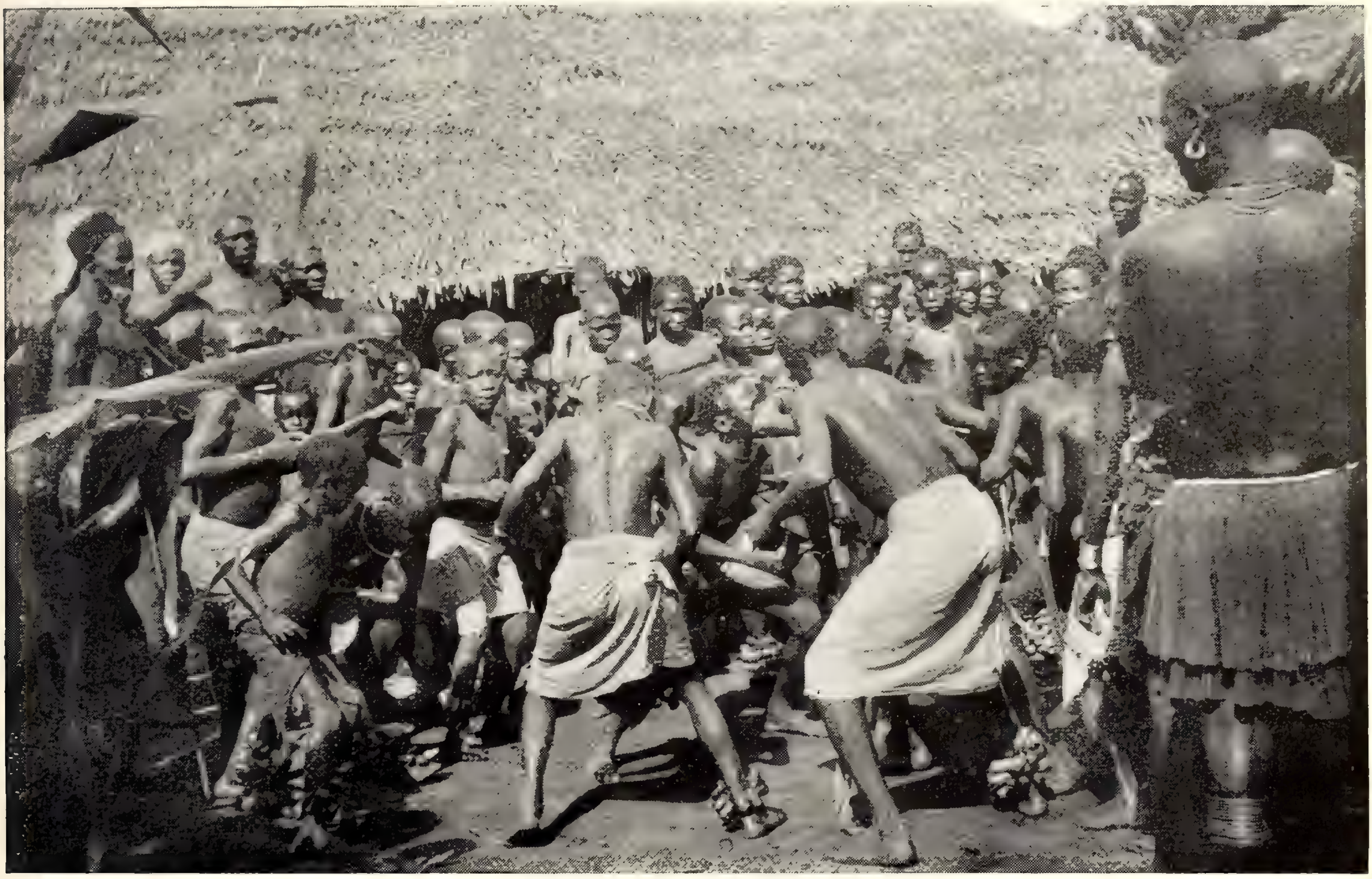
MR. ROOSEVELT AND BUFFALO COW IN PAPYRUS GRASS, SHOWING THE DANGER AND DIFFICULTY OF BUFFALO HUNTING, WHEN YOUR GAME MAY BE ONLY 5 YARDS AWAY

5,000 or 6,000 people. To my mind it is a very attractive little town. It is very much scattered out, and the wild beasts come right up to the edge of the town. A friend, Mr. McMillan, lent us the use of his house in town while we were staying there, and a leopard came up to the piazza one night after one of the dogs. On another occasion one of the local officials, a district commissioner, going out to dinner on his bicycle in a dress suit, and naturally unarmed, almost ran over a lion. Fortunately the lion was much frightened and went away. On two evenings in succession I dined at houses. The dinner was much as it would be in Washington, London, or anywhere else, the ladies in pretty soft dresses and the men in the usual evening garb of civilization. The houses were about a quarter of a mile apart, and a few days previous a young lady, in the early evening, while



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DANCE OF BOYS OF THE NYIKA TRIBE IN HONOR OF THE CHIEF'S SON, WHO HAD JUST DIED: NOTE THE RATTLES ON BOYS' ANKLES

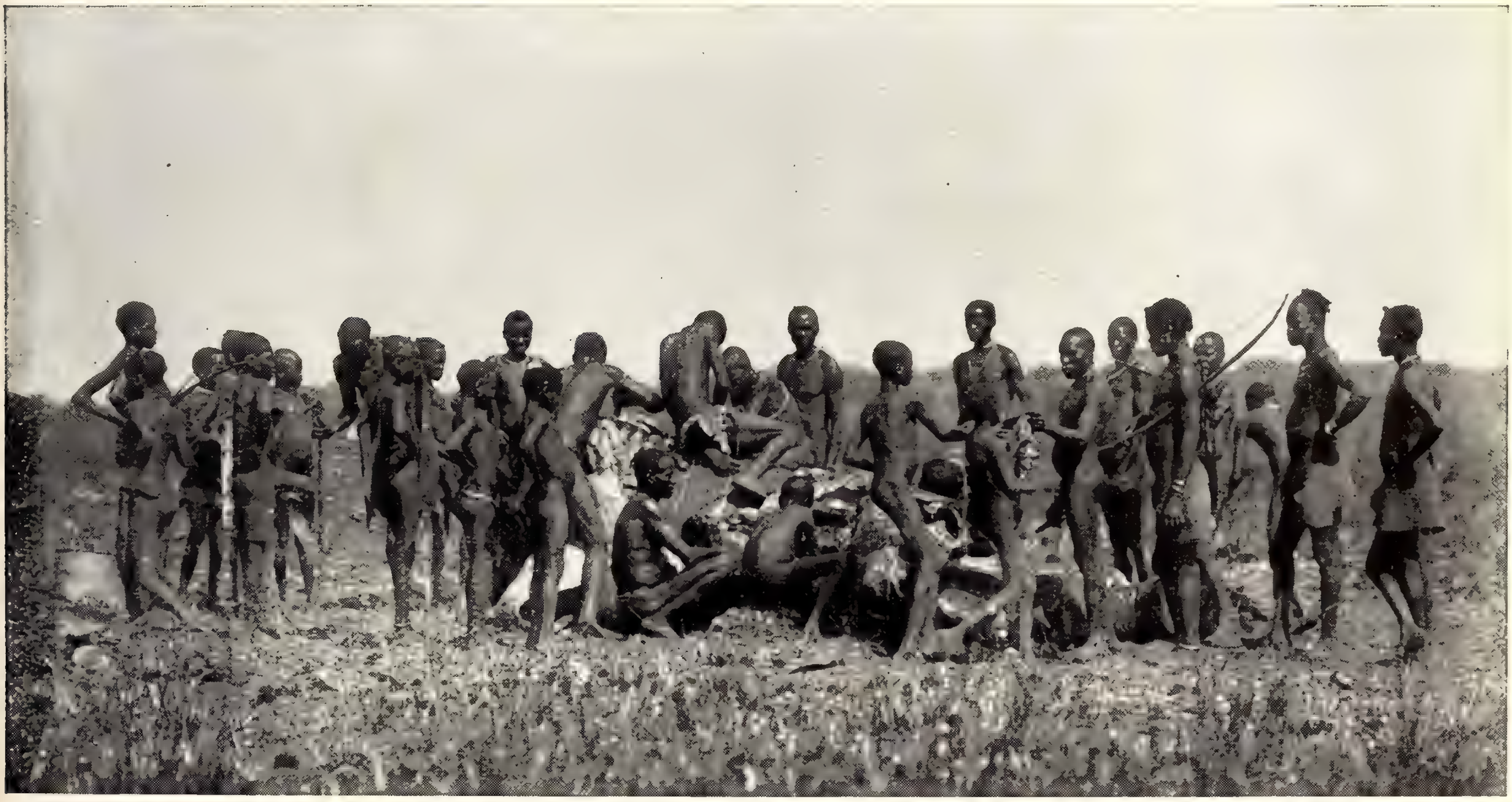


Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

GROUP OF NATIVES IN BELGIAN CONGO, NEAR RHINO CAMP, CUTTING UP AND TAKING AWAY THE MEAT OF AN ELEPHANT THEY KILLED WITH SPEARS

Photo by Heller. Copyright by Charles Scribner's Sons

TRUNK OF GIANT FIG TREE IN KENIA FOREST

bicycling from one to the other to take part in a rehearsal of "Trial by Jury," was knocked off her bicycle by a stampede of zebras, and was really quite hurt and had to give up the rehearsal. There was one incident to which really only Mark Twain could have done justice.

We all know—any of us who have had any dealings with government offices—the type of bureaucrat who upholds to the letter the rules of his office, even if the heavens fall. Among the "rules" out in East Africa are some excellent game regulations. The head of the reclamation service, a British army officer, Captain Smith, was trying to raise flowers and vegetables, and was much bothered because the zebra and antelope would come in and eat them. One night he heard some zebras in the garden and he sent out the gardener, a wild Masai, with instructions to drive the zebra out. The gardener killed a zebra; whereupon an upright judge *fined the gardener for killing game without a license!* I do not think that the most sensitive soul could object to my calling *that* judge fossilized.

Well, Captain Smith made up his mind that next time he would strictly observe all of the forms of law. So he arranged some wire entanglements around his garden, and when the next herd of zebras came in he and his gardener sallied out, and, when one of the zebras got tangled up in the wire, they captured him, took him down to the pound, and gave him to the poundmaster. The authorities, however, were equal to the situation. They advertised for two weeks for the owner of the zebra! The owner failing to appear, they then sold him at public auction to a citizen, who gave five shillings for him—which was probably at least five shillings too much.

The largest terrestrial mammal, next to the elephant, is the white rhinoceros. It was formerly found in South Africa, where it is practically exterminated. It was not supposed to exist anywhere else; but within the last few years it has again

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

OUR PORTER HARPER

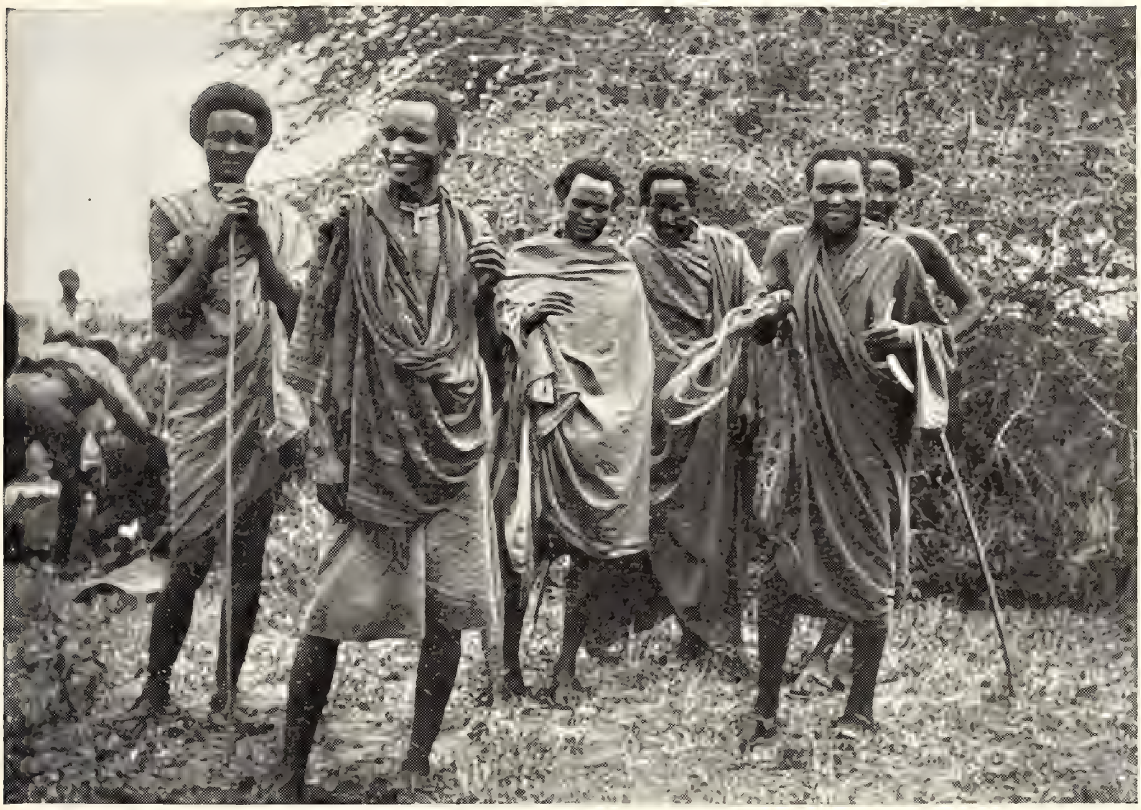
been discovered, along the headwaters of the Nile in mid-Africa. This is much as if the bison had only been known in Canada; had become exterminated there, and had finally been found again in Guatemala. There is just as wide a space of territory in between from which the species had totally disappeared. We obtained a full series of skins and skeletons of these huge beasts.

The two beasts that are the most interesting to my mind, as indeed they are to most hunters, are the elephant and the lion. A really successful effort is being made to preserve the elephant in East Africa. The bulls are only allowed to be shot after they have reached a certain point in the development of their tusks, and the cows and young stock are not allowed to be killed at all. The result is that, while of course there has been a diminution in the number of elephants, I think that they are now holding their own in many parts of East and Central Africa. Elephants are always interesting. It is rather exciting to study them in their haunts, because you have to watch them carefully, and there is some risk if you are discovered. I do not myself think that an elephant is quite as dangerous as a buffalo, and I think it considerably less dangerous than a lion.

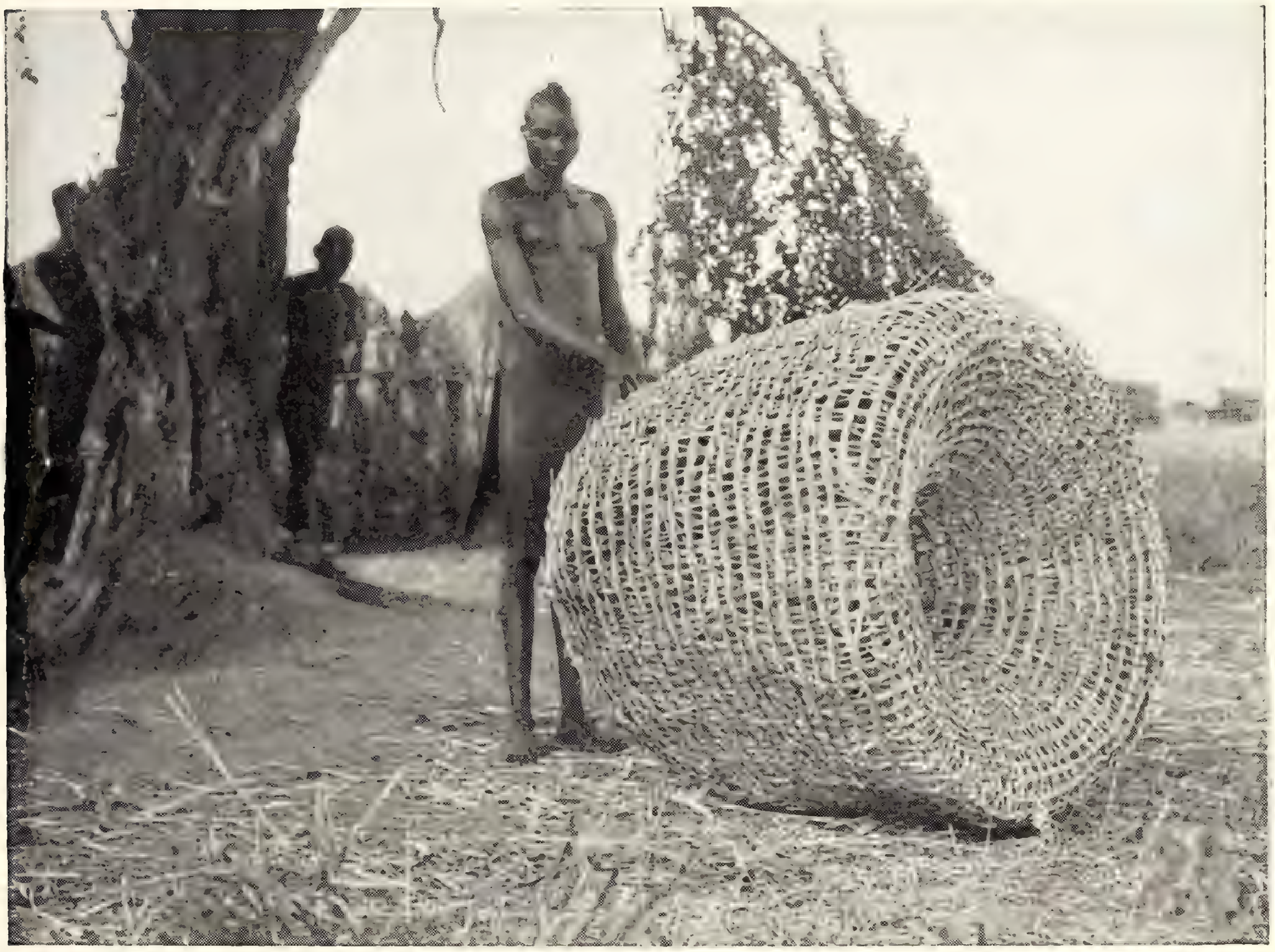
Photo by Heller. Copyright by Charles Scribner's Sons

TWO HIKUYU BOYS, FIRST ELEPHANT CAMP

Still, many of them are wicked, and they kill a good many people. When you get close to them and watch them for a time you will note that they are perpetually in motion. I have never seen an elephant entirely still. He will flap one ear; then he will suddenly put up his trunk and curl it and try to see if he can smell anything; then he will shift from one foot to another. They never seem to stand entirely still. When we were camping in the Lado, hunting white rhinoceroses, there were a good many elephants around. We had obtained our elephant series and did not want to molest them. Once, when walking about a mile and a half from camp, we suddenly saw a herd of 50 or 60 elephants accompanied by a flock of a couple of hundred white cow herons. When we first saw the elephants they were in an open flat, where the long grass had been burned. As the elephants walked through the short grass the herons marched alongside, catching the grasshoppers put up. As soon as they came to long grass all the herons flew up and lit on the backs of the elephants. There was one little pink elephant calf and two herons perched on its back. The elephants evidently did not mind the birds; otherwise they could have removed them with their trunks. Those elephants were quite indifferent to our presence if we did not come too near. While looking at them we heard Dr. Mearns shooting birds around camp; but it did not disturb the elephants. They stayed two days in the neighborhood, and we got as close a look at them as we wished. We did not want to have to shoot any of them; and, as an elephant cow will often attack a man if it thinks he is menacing her calf, we had to be cautious about going too close.



BORANS



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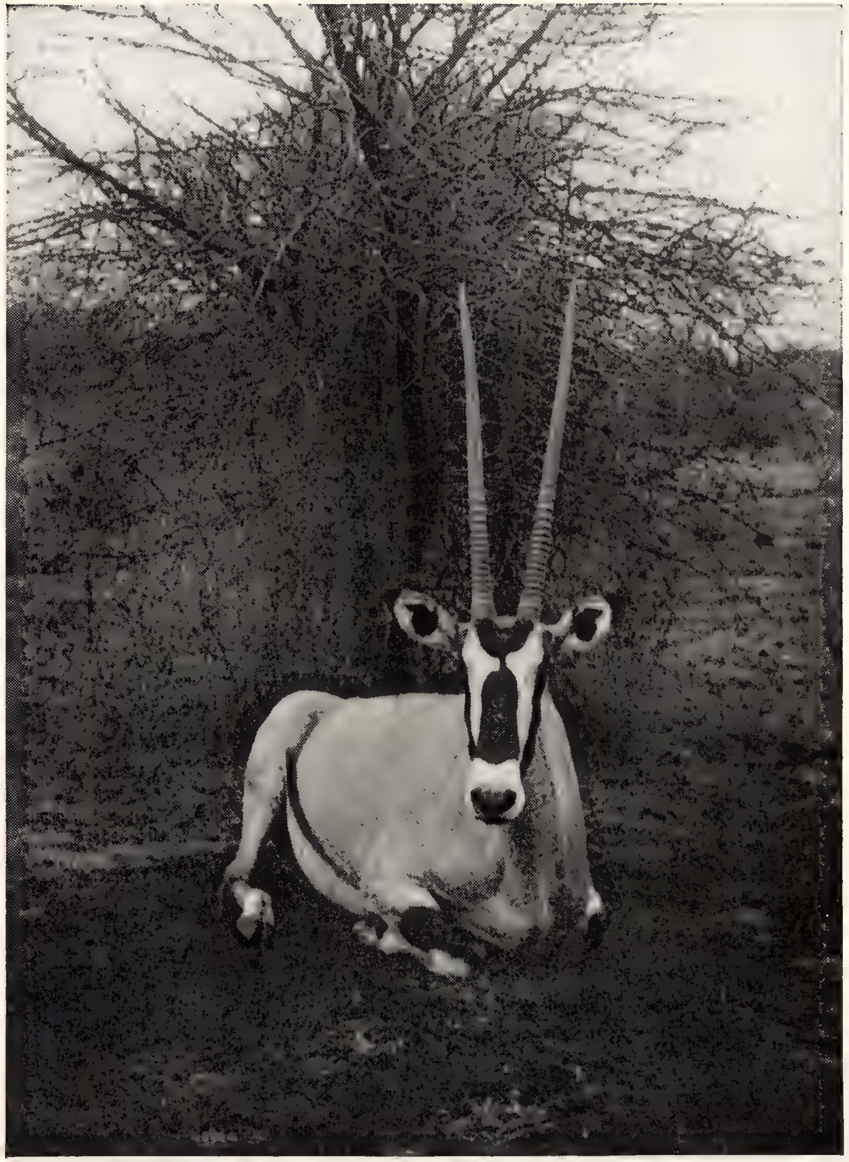
FISH TRAP: WADELAI



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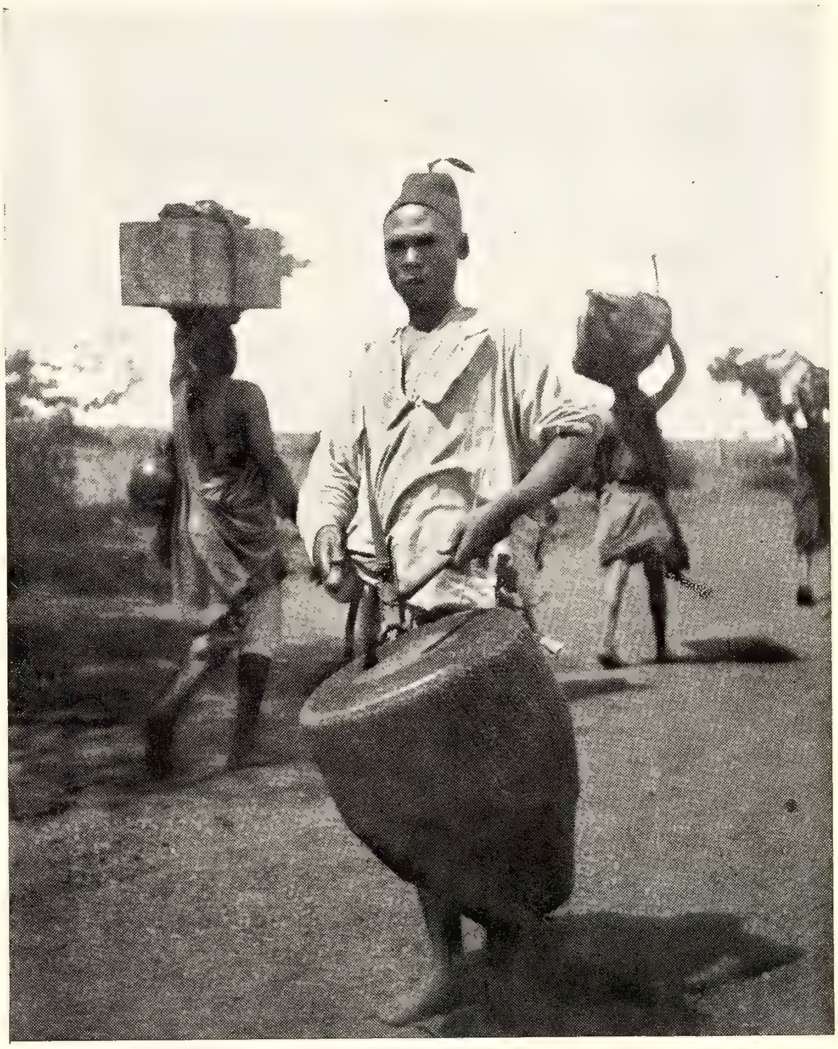
AN ORYX SHOT BY MR. ROOSEVELT

FUTURE WARRIOR TAKING A SIESTA

The elephant is the most intelligent of game. The rhinoceroses were not as interesting as the elephants, because they were not as intelligent. After we had completed our collection of rhinoceroses it became quite a problem how to avoid them and get the other things we wanted. It is amusing to realize how soon we got to accepting our difficulties with rhinos as a matter of course. Here in civilization, if you asked a man to kindly go down and scare off a rhinoceros for you, the man would look at you with a certain surprise; in Africa it was a matter-of-course incident. When near a rhino there is always a chance that he will charge, whether through stupidity, or fright, or anger. The trouble is that one never knows whether he will or will not charge home. It often happens that after he has come to a distance of about 25 yards he will wheel and run off; but, not being a mind-reader, a man cannot tell whether a particular rhino does or does not intend to charge home. Cuninghame, who was handling the safari for us, would now and then send me off to scare away rhinos who were too near the line of march, and I would perform the task with gingerly caution. Once Cuninghame and I were hunting buffalo on the Guaso Nairo. We were on the trail of a herd, when suddenly Cuninghame stopped, and, turning around with his air of patient dejection, said: "Oh, Mr. Roosevelt, look at that rhino." I answered, "Yes, look at him." He continued, "I do not want to lose this spoor. Would you mind going down and frightening him off? But do not make much noise, because we do not want to frighten the buffalo." So I strolled down, trying to make up my mind how much noise I could make that would frighten the rhino and not the buffalo. I struck just about the happy medium; and, after meditating a little, with his ears and tail up, the rhino trotted away in zigzags until it was safe for us to pass. About half a mile on we sighted the buffalo and started to stalk them. We were just finishing the stalk when there arose a yelling like that of lost souls behind us, and away went the buffalo. Back we went, to find that one of the porters, when we halted to drive off the rhino, had lost his knife; and he and two others took advantage of our stalking the buffalo to run back to see if they could find the knife. By that time the rhino had returned. Evidently he thought that his dignity had been offended, and he went for the porters and tossed one of them. So we had to give up the buffalo for the time being and go back and give first aid to the injured porter.



THE SAFARI DRUMMER

He would go on ahead to camp and then walk back, drumming to let the men know camp was near: Uganda. Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons.

The animal that I found most interest-

Photo by Kermit Roosevelt
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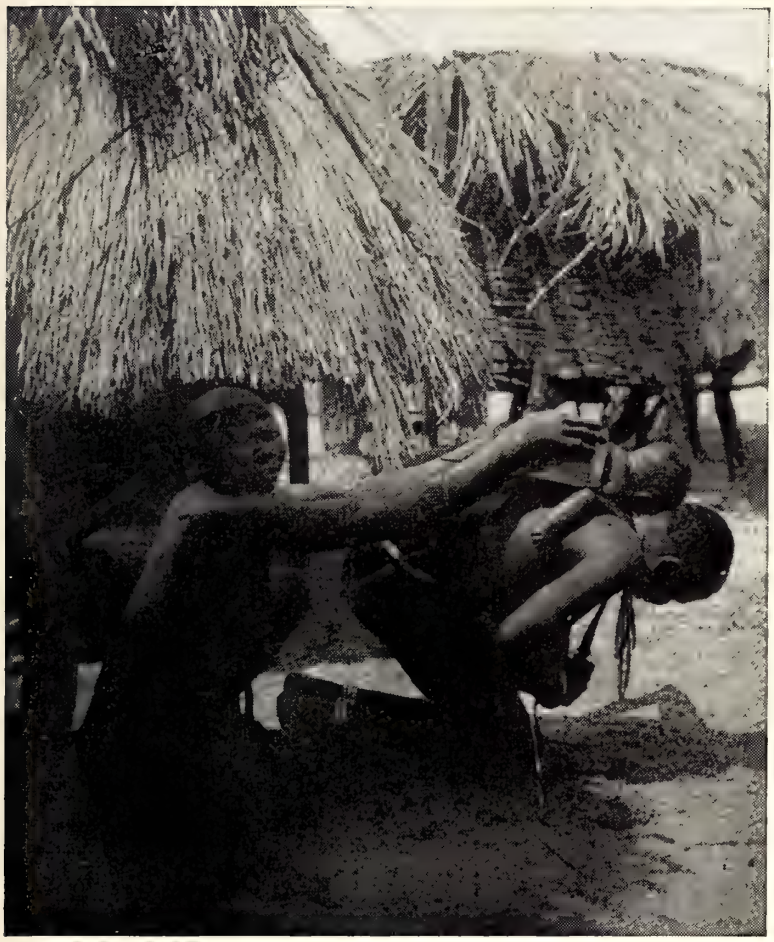
ANKOLI LARGE-HORNED CATTLE: UGANDA

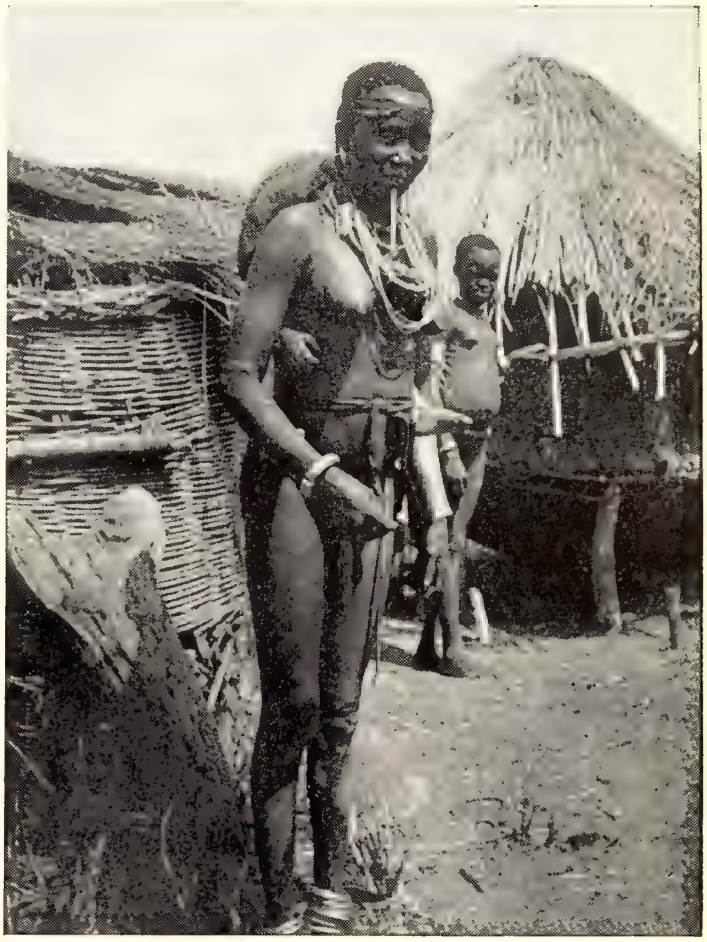
ing to hunt was the lion. I must tell one anecdote at the expense of two of my scientific companions. Dr. Mearns and Messrs. Heller and Loring all regarded the sporting part of the expedition as a pardonable but illegitimate incident of the trip, and the only anxiety that I ever knew any of them to display in connection with dangerous game was that we should not spoil the skull of a good specimen. One day when I was absent from camp Mearns and Loring were notified by a couple of Masai that two lions had killed a zebra a few miles off, and that if they would come out they could get them. They tossed up on the way as to which should have the lion and which the lioness, and Dr. Mearns drew the lioness. When they got there the lion had gone, so it was the Doctor's turn to shoot. He had been cautioning Loring on no account to shoot the animal in the head and spoil the specimen. But now the lioness put her head out of the bush directly toward the Doctor. He couldn't violate his principles and take the head shot; so Loring fired, hit the lioness, and it came for him. The Doctor's sporting blood was now up. He felt that it was not fair to interfere in an obviously equal match between Loring and the lioness; and, besides, if he shot at it he might hit the skull. Accordingly Loring was left to himself. He had a small automatic rifle; he put five bullets into the lioness and killed her; but she came right to his feet and stumbled past him 10 or 15 feet before she died. I think that Loring felt that he would have been willing that the Doctor should for a moment waive his scientific and sporting feelings and shoot the lioness!

The most interesting thing I saw in Africa was a feat that was infinitely greater than anything we performed with our rifles, although not greater than a feat that was recently performed in the same region by three American plainsmen, Buffalo Jones, Loveless, and Mearns, who roped a lion, a giraffe, and a rhino, and have got moving photographs of them. It was one of the really most notable feats I have ever known to be performed in hunting.

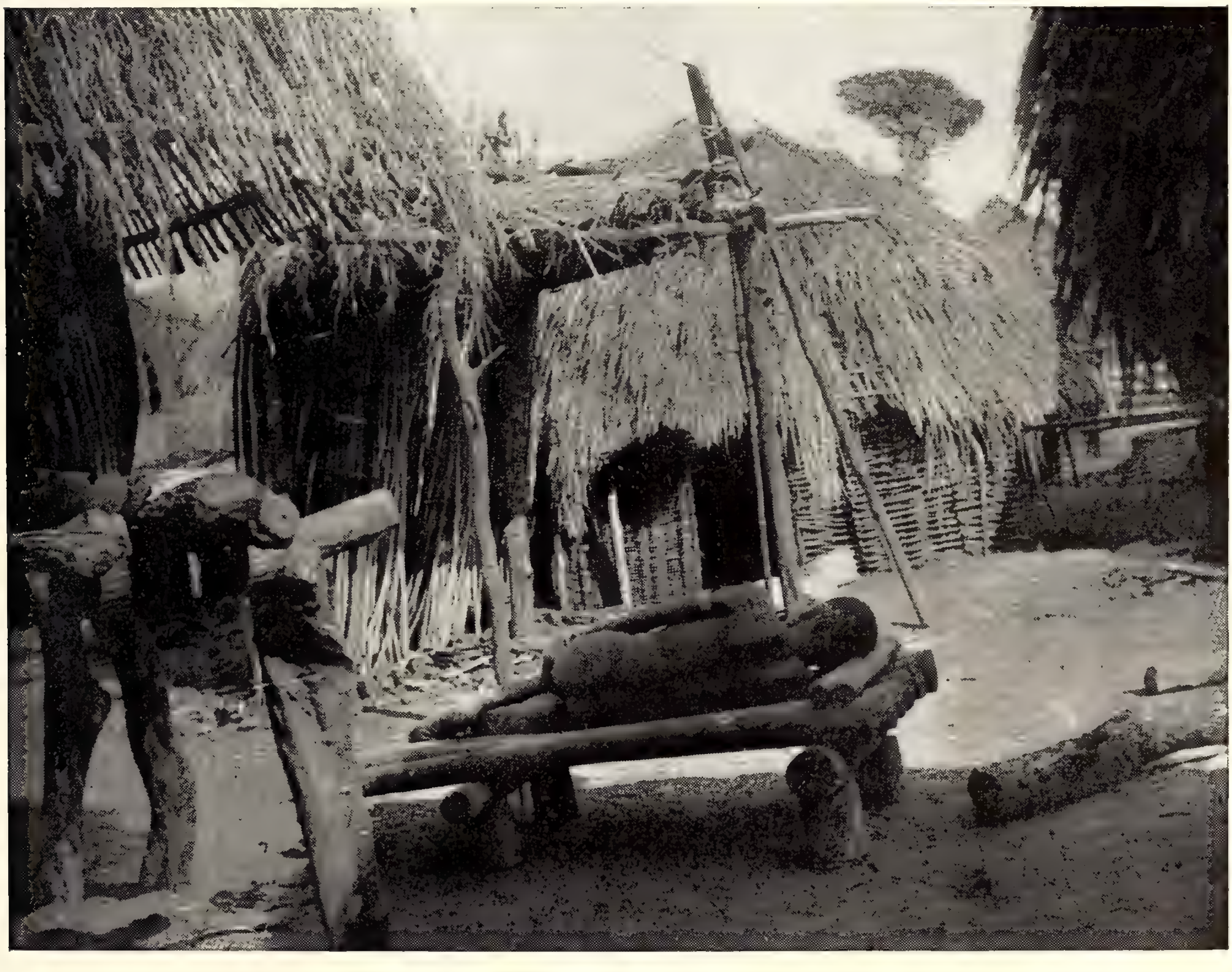
We saw the Nandi spearmen kill a lion with their spears, and I shall close my lecture by telling you about it. These people are a northern branch of the Masai. They are a splendid race physically—tall, sinewy fellows. The warriors carry ox-hide shields and very heavy spears, seven or eight feet long, the long-bladed head of soft iron kept with a razor edge and the iron of the rear half of the spear ending in a spike, the only wood that is bare being just about enough to give a grip for the hand. The brightly burnished head is about four feet in length. These Nandi came over on purpose to show me how they killed a lion with their spears.



FIXING THE BABY ON ITS MOTHER'S BACK



ON THE WOMAN'S BACK THERE IS A CHILD WITH HIS HEAD AND SHOULDERS COVERED BY HALF A GOURD



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CHILD SLEEPING ON A BED IN SARURU'S VILLAGE: IN THE GIANT ELAND COUNTRY

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

WOUNDED WILDEBEEST SHOT BY MR. ROOSEVELT

Several of us went out with them on horseback to round up a lion for them. We traveled three or four hours—half a dozen horsemen and 30 or 40 stalwart naked savages with ox-hide shields and spears. Then we roused a big lion with a fine mane, and, after running a mile or two, rounded him up under a bush, and the spearmen came trotting up. It was as fine a sight as I ever saw. The first spearman that came up halted about 60 yards from the lion. (We were watching him with our rifles to see that he did not attack the first spearman.) Then this man knelt down with his ox-hide shield in front of him, looking over the shield at the lion; and, as man after man came up, they formed a ring around the lion, all kneeling. The lion stood under the bush. As they closed in on him he began to grow more and more angry, roaring, and looking first to one side and then to the other and lashing his tail furiously. It was a fine sight to see these men make the ring, with their spears and their eager, intent faces, and the great, murderous, man-eating beast in the middle, ever growing more and more angry. As soon as the ring was completed they all got up and started to close in. The lion charged straight for the weakest part of the ring. The man in front braced himself; we could see his muscles all stand out as if he were a bronze statue. There were five or six men who took part in the fight. From each side the two or three nearest men sprang in to see if they could not get the lion as he came straight on toward the man in his immediate front. When he was about not more than six feet from him the man lobbed the spear; that is, he did not take his arm back and throw it, but simply cast it loose with a little motion of the

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

WILDEBEEST AT HOME

wrist and trusted to the weight of the spear to go in.

As the lion came forward the spear struck him on the left shoulder, and came out diagonally through him in front of his right hip. The lion reared like a rearing horse and bore the shield down, burying his teeth and claws in the man. At the same moment another man leaped in on one side and threw his spear; the spear-head glimmered like white fire in the sunlight, and, entering transversely, came out through the lion on the hither side. The lion turned on

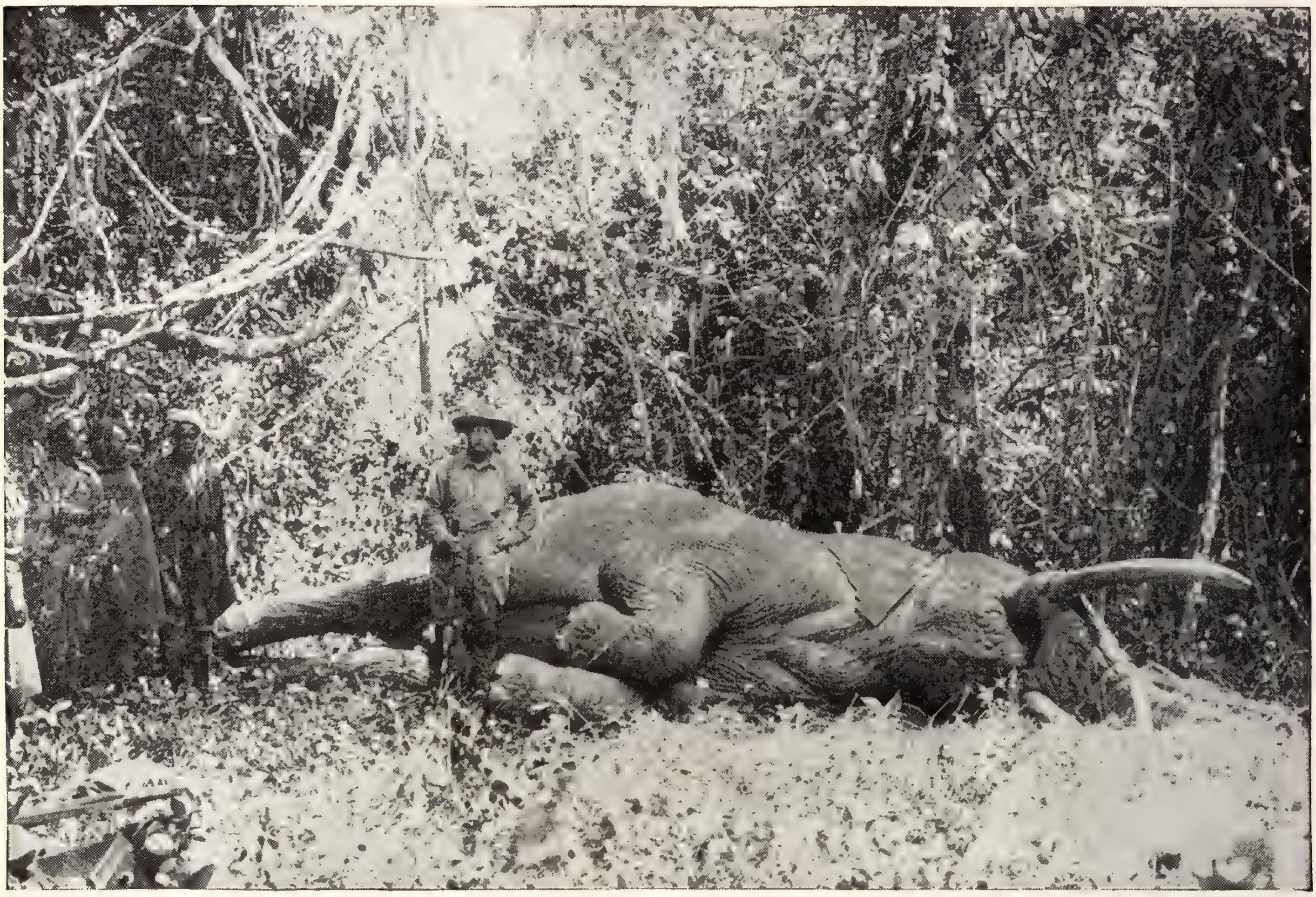
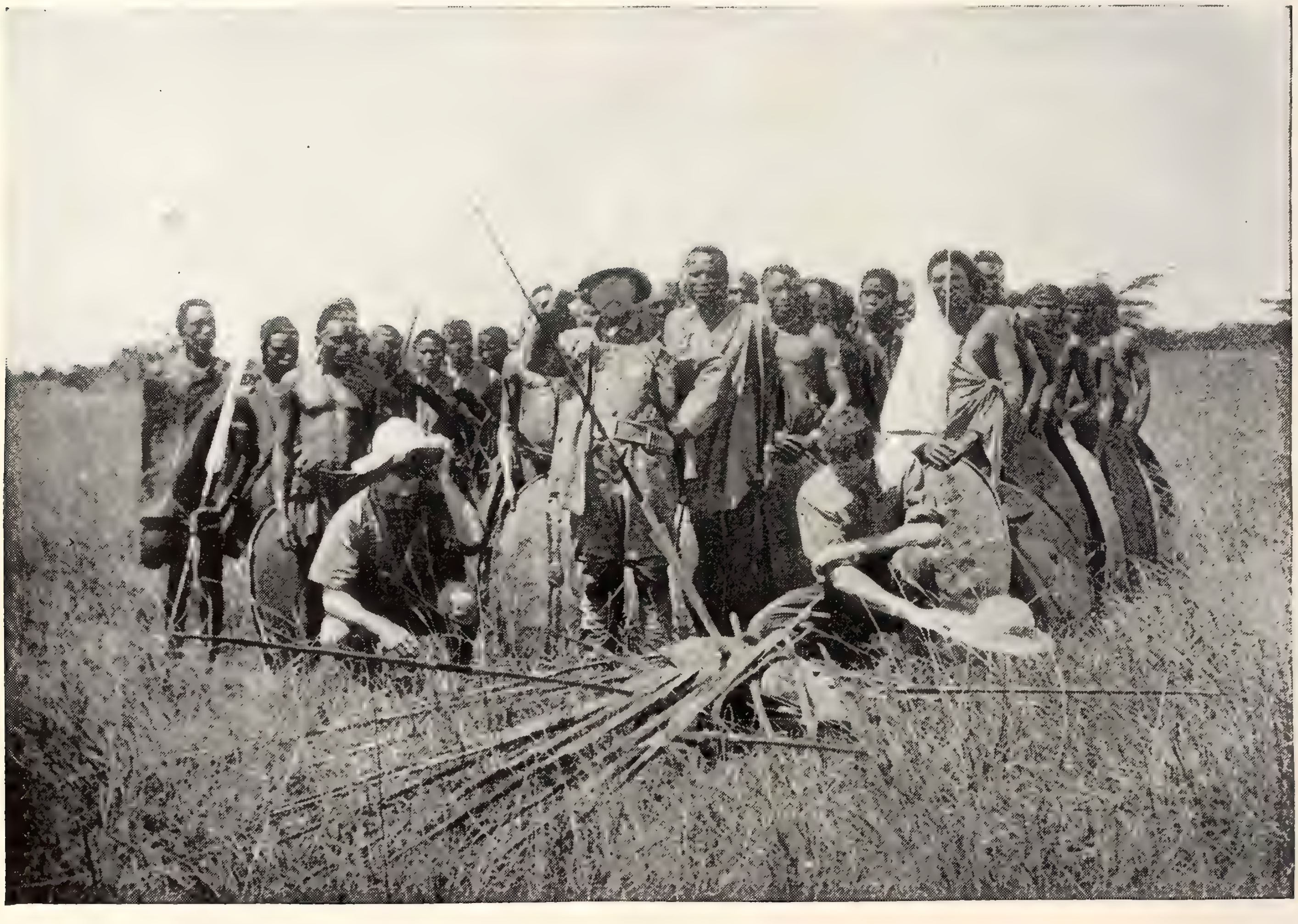


Photo by Cuninghame. Copyright by Charles Scribner's Sons

THE FIRST BULL ELEPHANT



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AFTER THE LION SPEARING

Photo by Kermit Roosevelt. Copyright by Charles Scribner's Sons

ARAB SHEIKS THAT CAME IN FROM THE DESERTS: KHARTUM

that man, but could not bite him, only clawing him a little. Another spear struck the lion, and he went down; he took one spear in his mouth and bit it, twisting it so that it looked like a horseshoe; the next moment the men were on him and it was all over. I do not suppose the thing lasted ten seconds, but it was as remarkable a spectacle for those ten seconds as any human being could wish to see. I had one funny after-experience in connection with it. The two men were pretty well mauled, and when we were putting disinfectant into the wounds it hurt them a little, and I thought it would cheer them up to tell them, through the interpreter, that I would give each of them a heifer. It cheered up those two all right, but all the other men were very angry! They thought that these men had got their share of honors already, and that it was a most unjustifiable thing for me to give them heifers in addition.

I have never passed a more interesting eleven months than I passed in Africa. From the standpoint of the man interested in geography, in geology, in natural history, in ethnology, I do not know how any one could put in his time to a greater advantage than in a trip of that nature. I am more than glad that I was able to take it in a manner worth taking, because the Smithsonian Institution sent me out as the head of a scientific expedition. I think I can say that we did our work in such a manner as not to cast discredit upon the American nation, and I am extremely pleased that I should have had the chance to make my first speech on the subject under the auspices of this Society this evening.

THE POPULATION OF THE UNITED STATES

By Henry Gannett

THE population of the United States as announced by the Bureau of the Census was, on April 15, 1910, 93,402,151. This figure includes not only continental United States, but its detached territories—Alaska, Hawaii, and Porto Rico. Excluding these territories, continental United States contained 91,972,266 inhabitants; or, in round numbers, 92,000,000, a number much larger than was generally anticipated.

Compared with the population of the same area in 1900, 75,994,575, our numbers increased in 10 years not less than 15,977,691, or at the rate of 21.0 per cent. The per cent of increase was slightly greater than in the preceding decade, 1890 to 1900, when it was 20.7 per cent.

It is probable that our natural increase has diminished considerably, but the net immigration—*i. e.,* the excess of arrivals over departures — has been decidedly greater, more than offsetting this decrease in the natural increase.

In the matter of numbers, this country of ours is the fourth on earth, being exceeded only by China, India, and Russia, all of them much lower in the scale of civilization than ourselves. Measured by efficiency, our 93 millions produce in the world's goods many times that produced by China's 420 millions, India's 300 millions, or Russia's 161 millions. The number of inhabitants exceeds those of the United Kingdom and France combined.

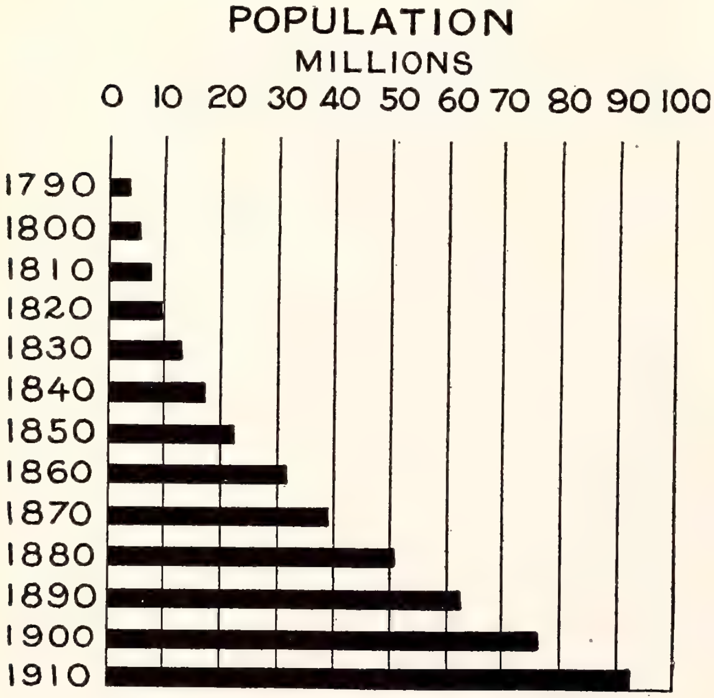
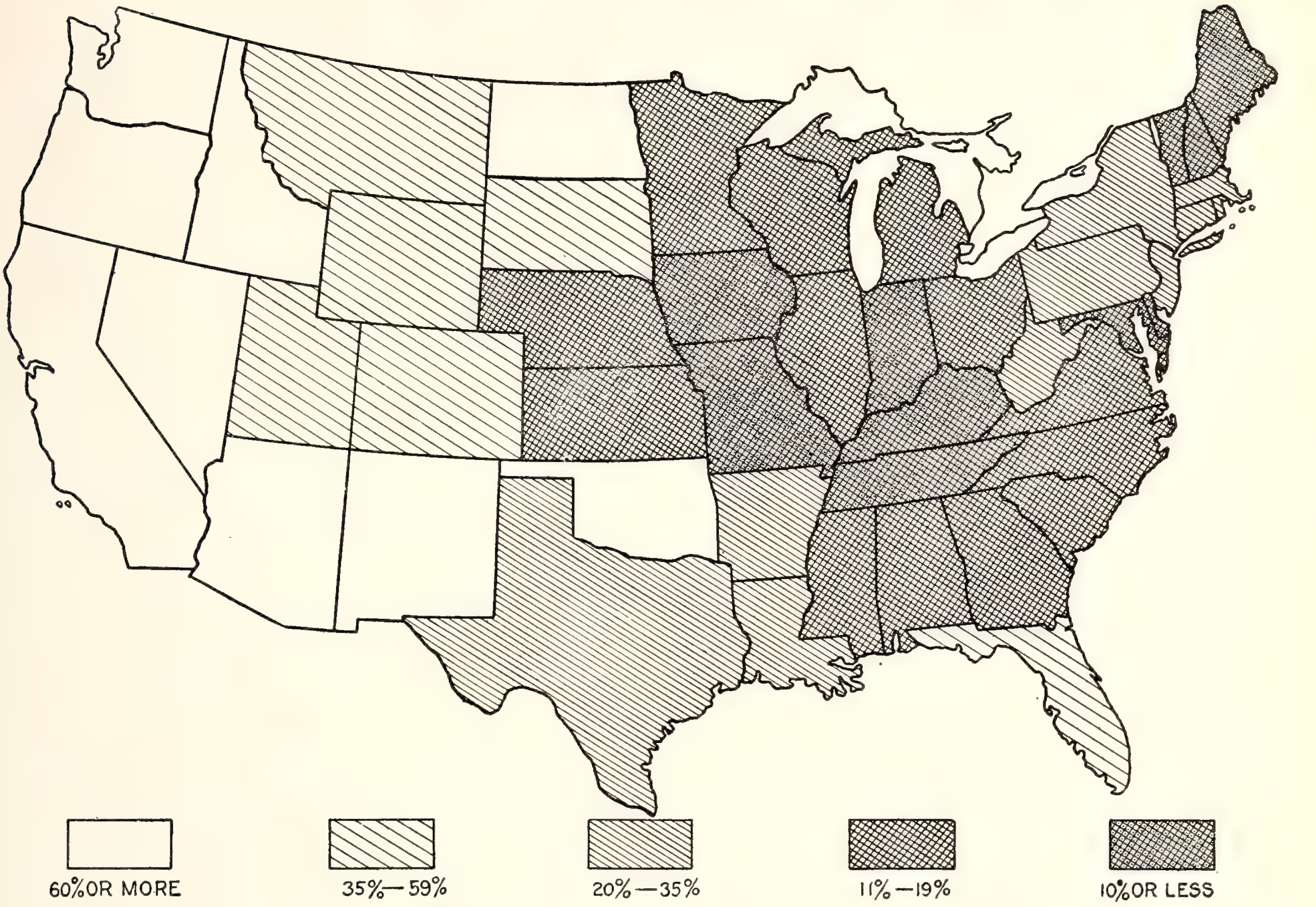


DIAGRAM SHOWING OUR POPULATION AT EACH CENSUS PERIOD

The decade 1890 to 1900 was one of depression in business, which showed itself in many ways, but perhaps most markedly in the decrease of immigration and increase in the number of returning immigrants, the result of which was to actually reduce the number of foreign born. This depression in business was felt more severely in the West than elsewhere, for to other causes was added the reduction in the price of silver and the consequent closing down of many mines of that metal.

In the decade just closed all this was changed. The times have been prosperous; immigrants have flocked to our shores in unprecedented numbers; the mines of the West have been reopened and are working full-handed; the farmers have produced full crops, and have realized high prices for them.

The first census was taken in 1790, and showed a population of a little less than four millions, spread along the Atlantic seaboard from Maine to Georgia. In this census little was done except to count noses. Every tenth year thereafter a census has been taken, and with each succeeding census the scope and variety and the value of the statistics have increased. At present the taking of a census is a very serious task. The population alone has multiplied nearly 25 times. The information which is obtained concerning the population is vastly greater than in the earlier censuses; and, moreover, we have for the past 60 years taken also a census of our industries and



MAP SHOWING THE RATE OF GROWTH THROUGHOUT THE UNITED STATES: 1900-1910

products, and one constantly increasing in complexity and value.

The cost of the first census was trifling; that of the thirteenth will probably be in the neighborhood of $14,000,000. In census-taking and in the presentation of its results the United States easily leads the world.

The following table shows the population at each census, the per cent of increase from census to census, and the density of population; *i. e.,* the average number of inhabitants to a square mile. These facts are shown graphically by the diagrams accompanying this article.

Population of Continental United States

Year.	Population.	Per cent of increase.	Density.
1790	3,929,214	....	4.9
1800	5,308,483	35.1	6.6
1810	7,239,881	36.4	3.7
1820	9,638,453	33.1	4.8
1830	12,866,020	33.5	6.4
1840	17,069,453	32.7	8.4
1850	23,191,876	35.9	7.9
1860	31,443,321	35.6	10.8
1870	38,558,371	22.6	13.3
1880	50,155,783	30.1	17.3
1890	62,622,250	24.9	21.2
1900	75,994,575	20.7	25.6
1910	91,972,266	21.0	30.7

The rates of increase, starting with 35.1 per cent in the earliest decade, diminished slowly during the first half century. Then, between 1840 and 1850 immigration increased with a rush, owing to famines in Ireland and political troubles in Germany, and the rate of increase suddenly rose. Since then it has declined greatly, as the country has filled up with people.

NO COUNTRY HAS GROWN SO RAPIDLY AS OURS

The growth of this country for the past 120 years has been most astounding. There is no record of any such growth in any other country. Though our growth has in the past 20 years slowed down greatly, yet it is at present much more rapid than that of any European country.

Australia and Canada have been under much the same conditions during the past century as the United States, and their relatively slow growth is difficult to explain. Moreover, while we can understand why half the population of Ireland has come to the United States, it is not easy to explain why a million and a quarter of British citizens have left their home for this country. One would suppose that if they wished to leave old England they would have gone to Canada or Australia. The case becomes still more difficult when we learn that there are about an equal number of Canadians in this country, two-thirds of whom are of English extraction.

The average number of people to a square mile, or the density of population, has been affected not only by our total number of inhabitants, but by the area of the country. In 1802 the great province of Louisiana was added to our original territory; in 1819, the Floridas; between 1840 and 1850, Texas and most of the southwestern States, and in 1852 the Gadsden purchase. As the population here treated is that of continental United States only, the addition of Alaska, Hawaii, and Porto Rico are not here considered, either as to population or area. In spite of all these additions, which have nearly quadrupled the original size of the country, the density of its population is now more than six times as great as 120 years ago.

The following table gives by States and Territories the population in 1910, the per cent of increase from 1900 to 1910, the density of population in 1910, and, in the last column, the proportion which the number of inhabitants of cities of 25,000 or more bears to the population of the State. The States are arranged in geographic instead of alphabetic order, so that those having similar characteristics may be placed near one another.

Population, Rate of Increase 1900–1910, Density of Population, and Per Cent of Increase of States.

	Population, 1910.	Per cent of increase.	Density.	Per cent urban.
Maine	742,371	7	25	11
N. Hampsh'e	430,572	5	48	22
Vermont	355,956	4	39	0
Mass.	3,366,416	20	420	64
Rhode Island	542,610	27	517	68
Connecticut..	1,114,756	23	230	45
New York...	9,113,614	25	191	69
New Jersey..	2,637,167	35	337	52
Pennsylvania.	7,665,111	22	170	39
Delaware ...	202,322	10	103	43
Maryland ...	1,295,346	9	131	43
Dist. of Col..	331,069	19	...	100
Virginia	2,061,612	11	51	14
West Va.....	1,221,119	27	50	6
N. Carolina..	2,206,287	17	45	3
S. Carolina..	1,515,400	13	52	6
Georgia	2,609,121	18	44	12
Florida	752,619	42	14	13
Alabama	2,138,093	17	43	10
Mississippi ..	1,797,114	16	39	0
Louisiana ...	1,656,388	20	36	22
Texas	3,896,542	28	15	12
Arkansas ...	1,574,449	20	30	3
Oklahoma ...	1,657,155	110	24	6
Tennessee ...	2,184,789	8	52	15
Kentucky ...	2,289,905	7	57	15
Ohio	4,767,121	15	117	37
Indiana	2,700,876	7	75	18
Illinois	5,638,591	17	101	46
Michigan ...	2,810,173	16	49	30
Wisconsin ...	2,333,860	13	43	25
Minnesota ..	2,075,708	19	26	30
Iowa	2,224,771	0	40	15.
Missouri	3,293,335	6	48	33
N. Dakota...	577,056	81	8	0
S. Dakota...	583,888	45	8	0
Nebraska ...	1,192,214	12	15	16
Kansas	1,690,949	15	21	11
Montana	376,053	55	3	10
Wyoming ...	145,965	58	1	0
Colorado ...	799,024	48	8	36
N. Mexico...	327,301	68	3	0
Arizona	204,354	66	2	0
Utah	373,351	35	5	32
Idaho	325,594	101	4	0
Nevada	81,875	93	1	0
California ...	2,377,549	60	15	45
Oregon	672,765	63	7	31
Washington..	1,141,990	120	17	37
Alaska	64,356			
Hawaii	191,909			
Porto Rico..	1,118,012			
Military and Naval.....	55,608			

THE STATES THAT HAVE INCREASED MOST RAPIDLY

New York is, as it has been continuously for 90 years, the most populous of all the States, having now more than 9,000,000 inhabitants. This is more than double the population of the entire country in 1790, and very nearly equal to its population 30 years later, in 1820.

Our second State in population is Pennsylvania, which has held that position since 1830. Then follow in order Illinois and Ohio, which held the same positions in 1900. Going on down the list, changes in rank occur, and in some cases these changes are great. Thus, California jumps from twenty-first to twelfth place.

Twelve States hold the same rank in 1910 as in 1900; all the others have changed places, the sum of the changes being 90, or an average of nearly two places to each State. The changes in rank which occurred between 1890 and 1900 numbered 65 only, illustrating the fact that the increase in population of the different States have differed much more widely in the last decade than in the previous one. The range among these increases was from Nebraska, which suffered a slight loss, up to Washington, Oklahoma, and Idaho, which more than doubled their numbers.

The map on page 35 shows the distribution of the rates of increase by States. Of the Atlantic States, the great manufacturing States of Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania, with the mining State of West Virginia and the frontier and winter-resort State of Florida, increased at rates more rapid than did the entire country. Massachusetts, however, very nearly reached it. Of the central States, only the frontier States of North Dakota, South Dakota, Oklahoma, and Texas increased more rapidly than the country at large, while all the western States increased more rapidly.

In the central part of the country there is an area which has grown very slowly, less than 10 per cent, while Iowa, which is within this area, has actually lost a few thousand inhabitants. Illinois, although in the midst of this area, was saved from finding itself in the same class as its neighbors only by the fact that it contains the great city of Chicago, with its rapid growth. These States, from Indiana west to the Mississippi River, are at present quite fully populated for agricultural States. They offer little inducement to immigrant farmers to come or to the sons of farmers to remain. In short, they have nearly reached the limit of a farming population. Other industries which will permit and require a greater density of population, such as manufactures and commerce, must be introduced before a more rapid growth can be resumed.

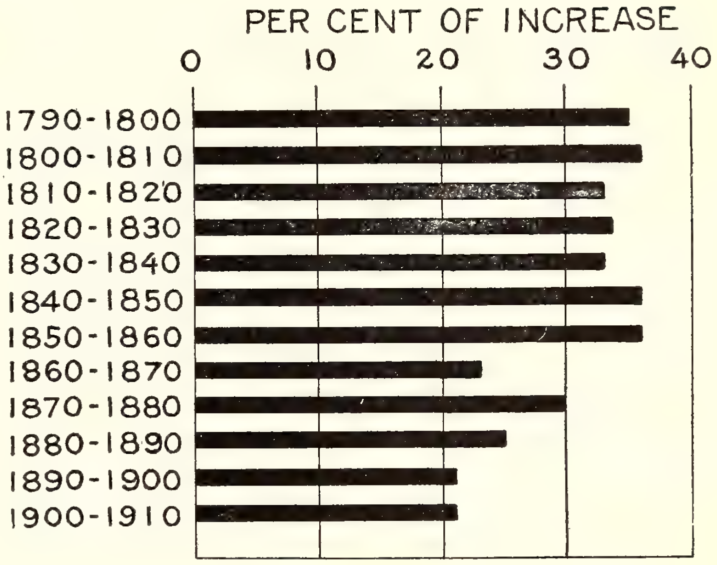


DIAGRAM TO ILLUSTRATE OUR RATE OF GROWTH BY DECADES

This illustrates one of several phases in the peopling of a country. The first settlement represents commonly the pastoral interests, which require large areas of land to support few persons. Later, perhaps when railroads have made the region accessible, farmers will enter it and take possession, perhaps slowly and gradually, or perhaps with a rush, as illustrated by their recent invasion of Oklahoma. Then comes the condition typified by the central States, where a farming community has reached its maximum, or nearly so. Following that commonly comes the development of manufactures and the attendant building of cities, which attract people and cause a more rapid growth.

Twenty or thirty years ago Ohio was in much the condition in which Iowa is today. Since then the development of her cities has sent her forward again.

The rapid growth of southern New England and of the other North Atlantic States is due almost entirely to their cities. The agricultural element is almost at a standstill there. The growth of the cotton States, ranging from 14 to 20 per cent, is the normal growth of agricultural communities not yet nearing the maximum density for that industry. Texas,

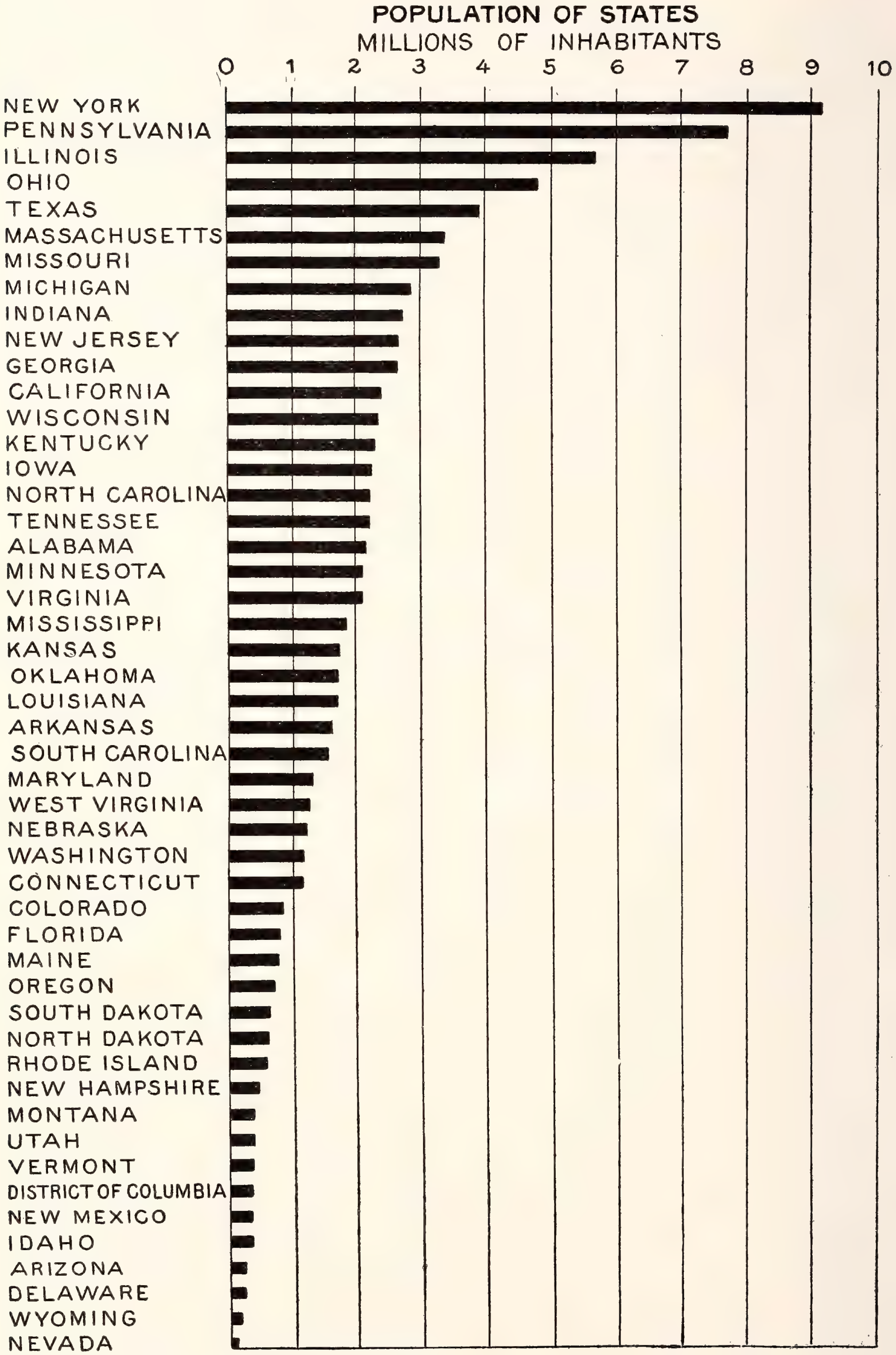


DIAGRAM COMPARING THE POPULATION OF THE VARIOUS STATES

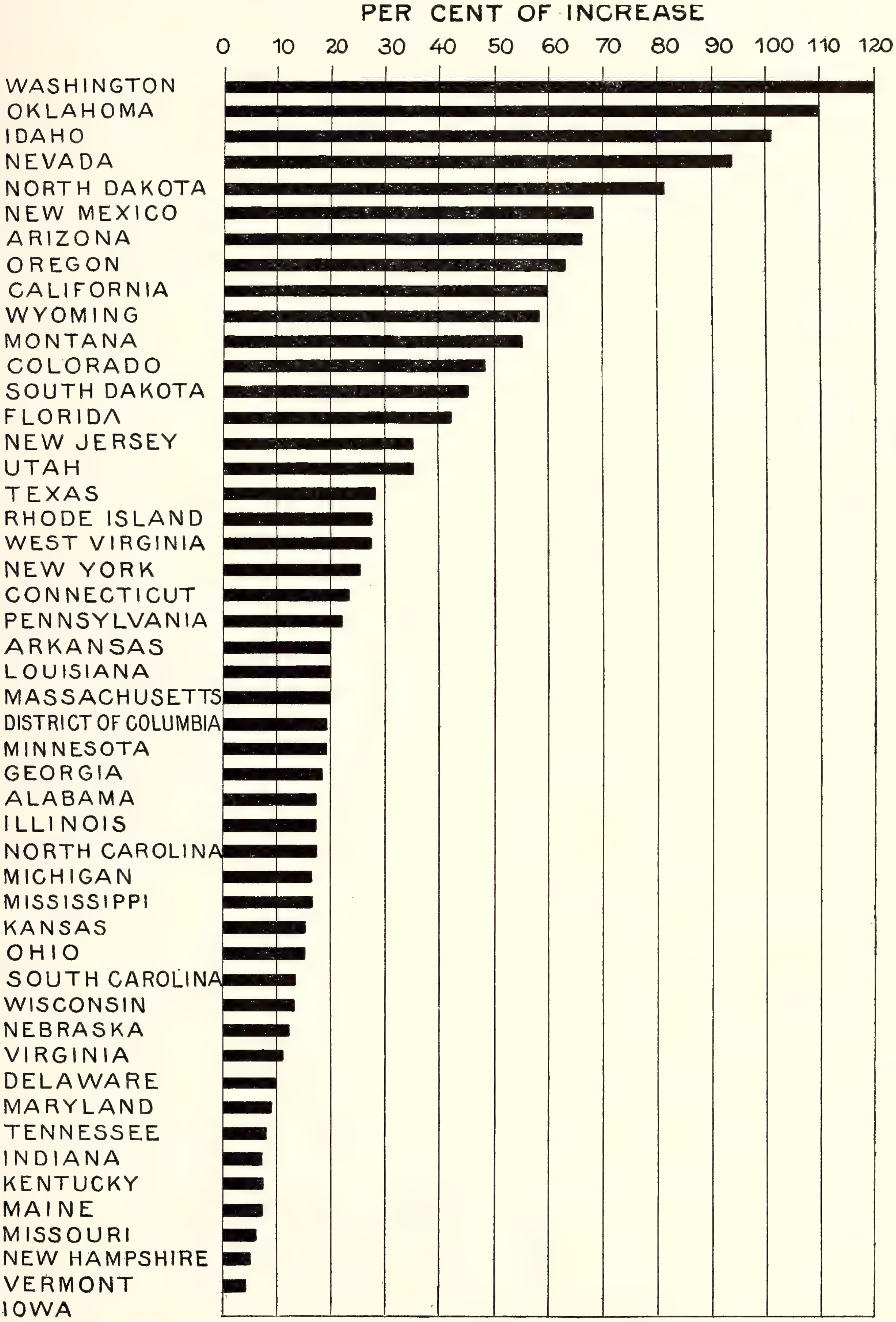


DIAGRAM TO SHOW THE RATE OF GROWTH OF THE STATES

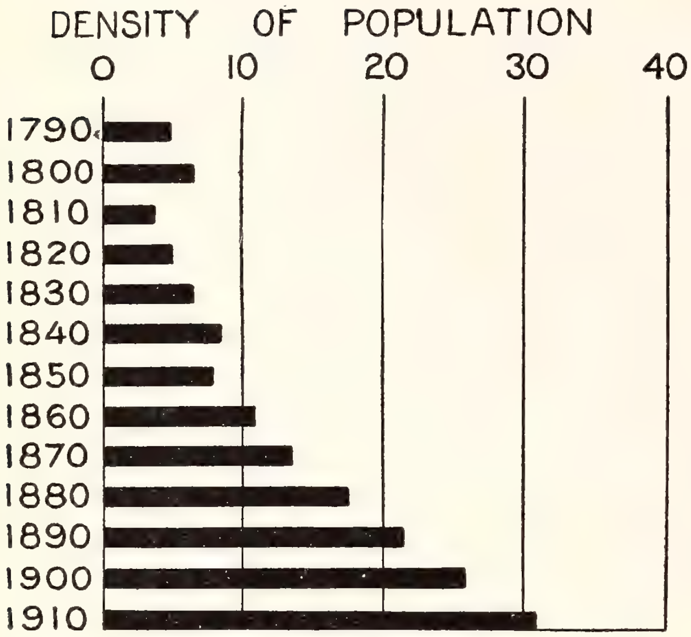


DIAGRAM SHOWING THE NUMBER OF INHABITANTS PER SQUARE MILE AT EACH CENSUS PERIOD

the Dakotas, and the entire West are filling up their waste places, while in many places, as in Nevada, mining is playing a part.

REMARKABLE GROWTH OF PACIFIC COAST STATES

The most phenomenal growth has taken place on the Pacific coast. The three States bordering the western ocean show the following percentages of increase: California, 60.1; Oregon, 62.7, and Washington, 120.4. These three States together contributed 1,775,612 to the increase of the country, or 11 per cent of the total amount. Their contribution was nearly as great as that of the empire State of New York, and far larger than that of any other State. The increase in these States consisted mainly in the growth of cities and in filling up the well-watered regions near the coast.

OUR DENSITY OF POPULATION COMPARED TO THAT OF EUROPEAN COUNTRIES

In density of population the States show the widest sort of variations, ranging from 517 inhabitants to a square mile in Rhode Island, 420 in Massachusetts, and 337 in New Jersey, down to less than 1 to a square mile in Nevada. The most densely populated countries of Europe are Belgium, with 587, and Netherlands, with 408.

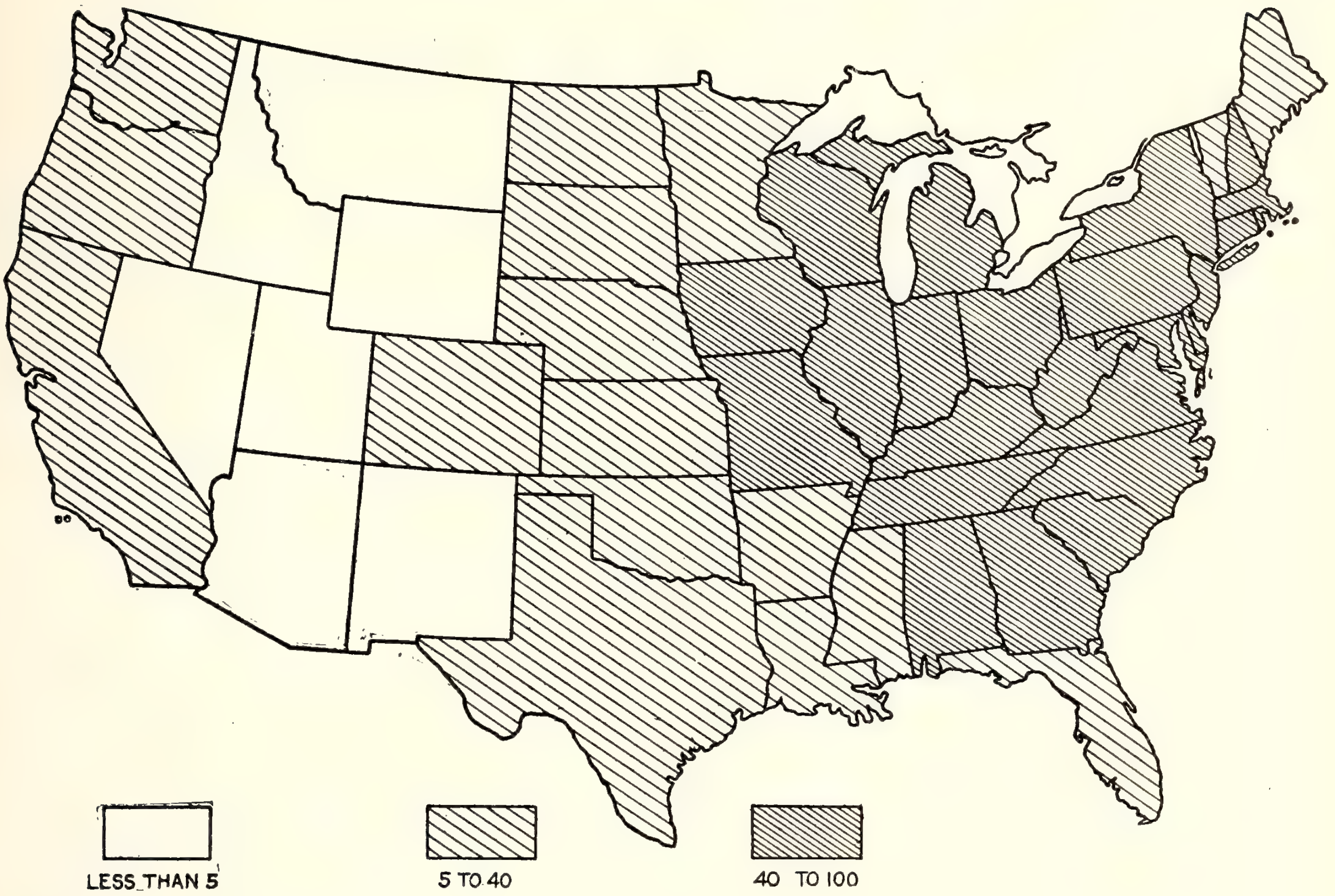
The great manufacturing States of the Northeast have an average density of more than 200 to a square mile. The agricultural States south of the Potomac and Ohio have about 40 to a square mile, the density decreasing southward and westward. Those of the upper Mississippi Valley east of the great plains are equally well populated.

The plains States—the Dakotas, Nebraska, Kansas, and Oklahoma—still have great vacant spaces to be filled, as they support now on an average not over 15 to a square mile.

In all the mountain States the population is sparse, ranging from less than 1 inhabitant to a square mile in Nevada up to 8 in Colorado. The three Pacific States are much more fully populated, but there is still room for two or three times as many people before the agricultural limit will be reached.

In running down these columns of figures, it is interesting to note that, in the agricultural States, as the density of population increases the rate of increase diminishes. Consider, for instance, the Carolinas, Georgia, and Florida. South Carolina, with the greatest density, has the lowest rate, North Carolina next, then Georgia, while Florida, with much the lowest density, has far the highest rate. Kentucky and Tennessee show the same phenomena. Indeed, as a general statement, it applies to all the agricultural States.

The increase of population was largely in the cities, and not alone in those of 100,000 or more inhabitants, but perhaps in equal measure in smaller ones. The total population in cities of 25,000 or more inhabitants was 28,508,007, leaving 63,464,259 in smaller towns and in rural communities. In 1900 the corresponding figures were 21,078,189 and 54,916,386. The cities grew at the rate of 35 per cent, while the smaller places and the rural districts increased at the rate of only 15.5 per cent. In 1900 these cities



OUTLINE MAP TO SHOW THE DENSITY OF POPULATION OF THE UNITED STATES: THE NUMBER OF INHABITANTS PER SQUARE MILE

contained 28 per cent of the total population, while in 1910 they contained not less than 31 per cent. Of the total increase in population, 46 per cent was in these cities and 54 per cent in the remainder of the country.

THE MANUFACTURING STATES

In a general way we may, on the basis of the last column of the table on page 36, classify the States as urban and rural, or by their prevailing industries, as manufacturing and commercial on the one hand and agricultural on the other. The criterion is not a perfect one, as the minimum of city population, 25,000, is too high. If urban centers down to 2,500 inhabitants were included, the results might, in certain cases, be different. Moreover, in measuring the ruling industry of a State by the relative magnitude of its city population, we find in several cases that a single city induces the result. Thus, Illinois as a whole is a manufacturing State; *i. e.*, nearly half its people are in cities, engaged in those avocations carried on only in such communities; but, outside of Chicago, Illinois is distinctly a farming community. The same is the case in Maryland outside of Baltimore, and Delaware outside of Wilmington.

Drawing the line at a little below 40 per cent of urban population, so as to include Pennsylvania and Ohio, both well known as predominantly manufacturing States, we may make the following classifications:

Manufacturing and Commercial States: Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia, Ohio, Illinois, California, Washington.

Agricultural States: Maine, New Hampshire, Vermont, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Arkansas, Oklahoma, Tennessee, Kentucky, Indiana, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota,

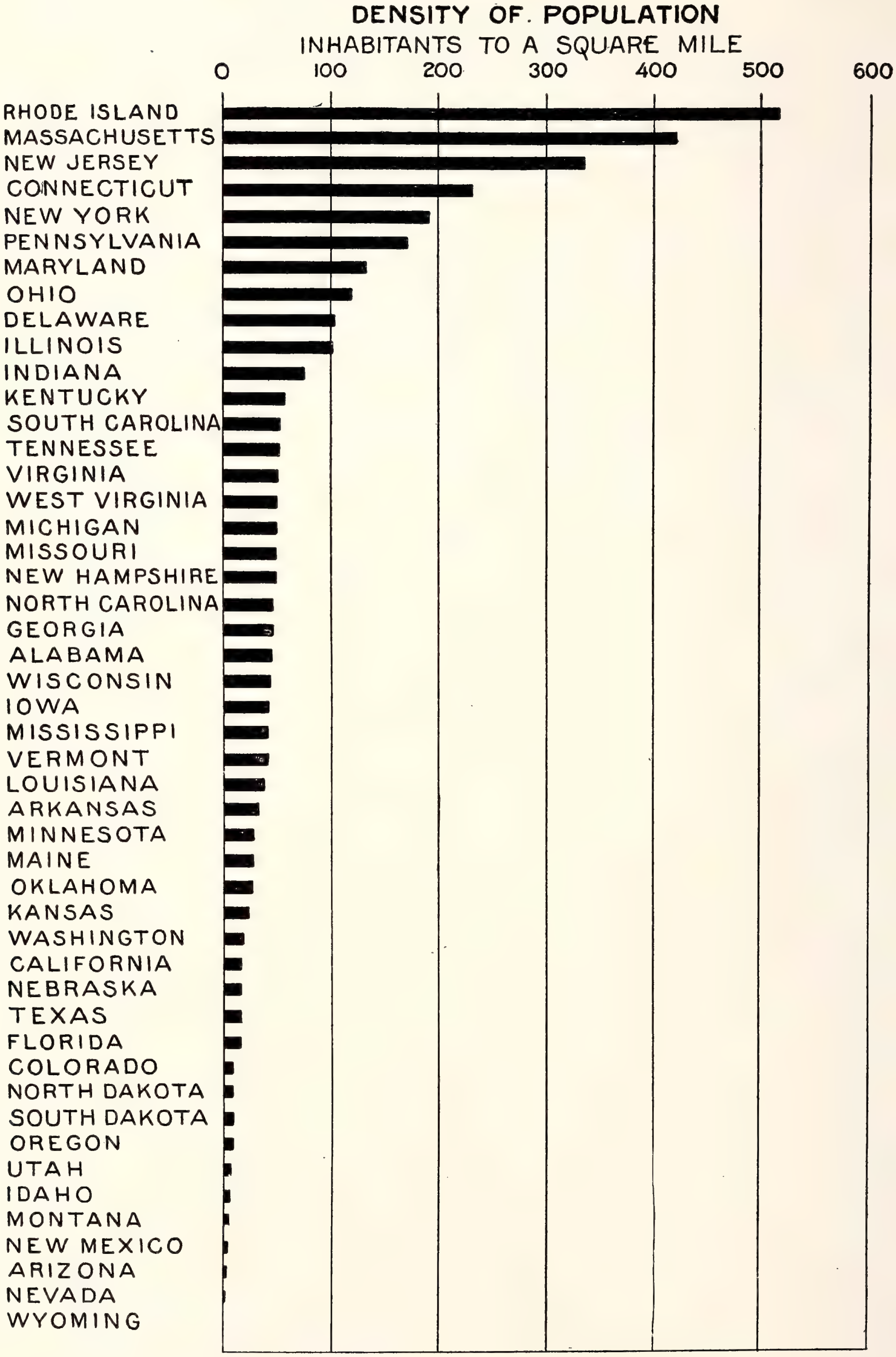
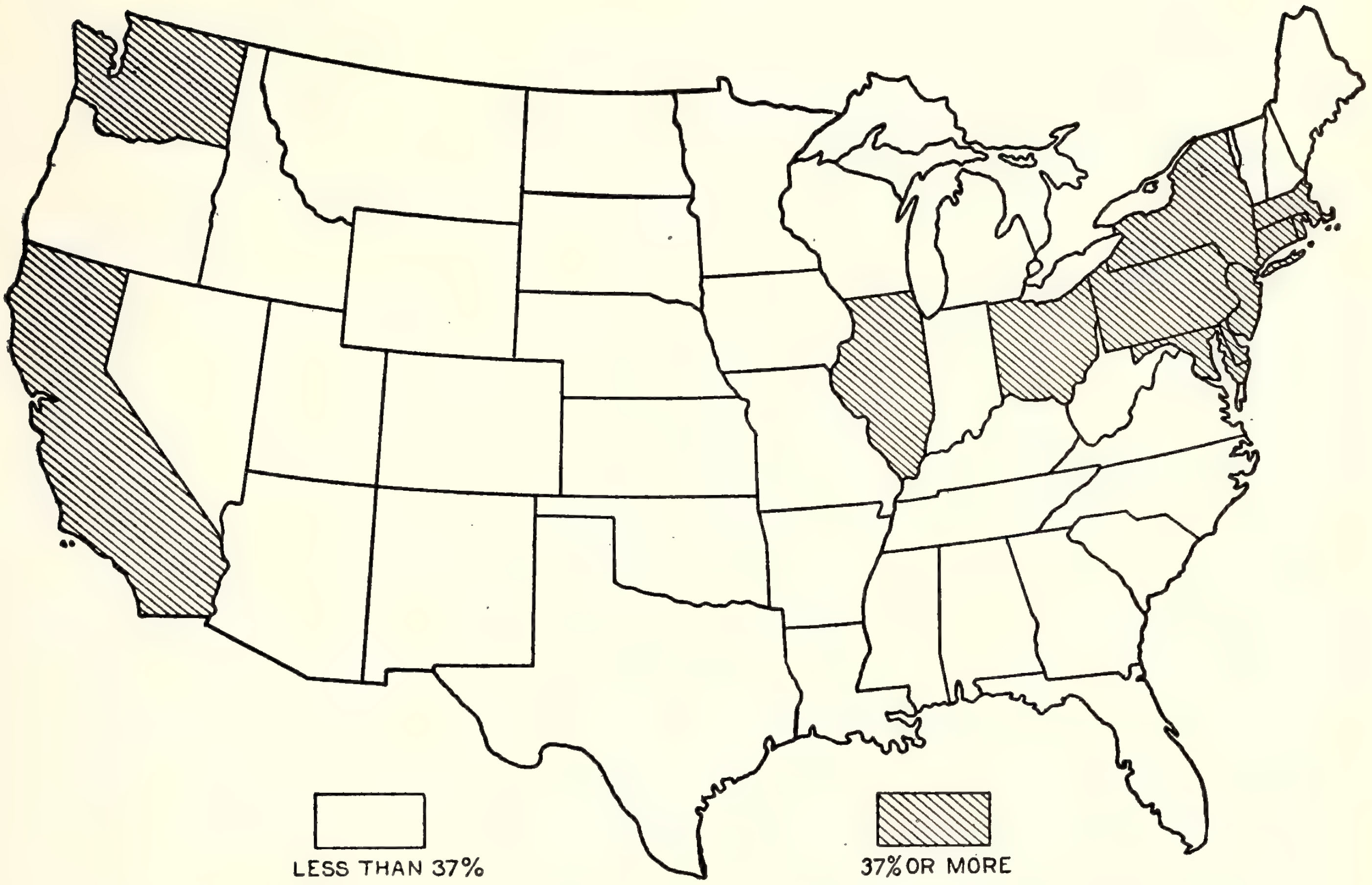


DIAGRAM TO SHOW THE DENSITY OF POPULATION OF THE VARIOUS STATES



MAP SHOWING THE PROPORTION OF URBAN TO TOTAL POPULATION

Nebraska, Kansas, Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, Idaho, Nevada, Oregon.

It will be noted that all the States south of the Potomac and Ohio rivers, without exception, are agricultural, and that those of the upper Mississippi Valley, with the exception of Illinois and Ohio, are of similar character; that the North Atlantic States, excepting Maine, New Hampshire, and Vermont, are manufacturing and commercial, and that the western States, excepting California and Washington, are predominantly agricultural.

OUR CITIES HAVE GROWN MUCH MORE RAPIDLY THAN THE COUNTRY

The distribution of the urban element is very irregular. One-half of the dwellers in cities of 25,000 or more inhabitants were in the North Atlantic States, while in the northern States—*i. e.*, those north of Mason and Dixon line, the Ohio River and the southern boundary of Missouri and Kansas—were not less than four-fifths. In the western States were 8 per cent, while in all the southern States there were only 12 per cent.

In every State the urban element, defining it as above, has grown more rapidly than has the rural element, or the remainder of the population, in a number of cases many times as rapidly. Thus, in New York, while its cities have increased 42 per cent, the rural element has grown only 2 per cent; in Massachusetts the corresponding proportions are 32 per cent and 4 per cent, and in Ohio 48 per cent and 1 per cent. The cities have shown a very rapid growth, ranging from 141 per cent in Oregon and 140 per cent in Washington, down to 13 per cent in Kentucky and 14 per cent in Delaware and Maryland.

In four States, viz., New Hampshire, Rhode Island, Iowa, and Missouri, the rural population shows a decrease, while in Maine, New York, North Carolina, Michigan, and Ohio the gain of this element of the population has been trifling.

In 1900 there were 38 cities having 100,000 or more inhabitants each. During the decade following, this number was diminished by two — Allegheny, Pennsylvania, was annexed to Pittsburg, and Saint Joseph, Missouri, apparently lost a large number of inhabitants, leaving it fewer than 100,000 in 1910. During the decade 14 other cities passed the 100,000 mark, making 50 such cities in 1910.

The following table gives the population and rate of increase of these cities:

Cities of 100,000 or More.

City.	Population.	Per cent of increase.
New York, N. Y.......	4,766,883	39
Chicago, Ill............	2,185,283	29
Philadelphia, Pa.......	1,549,008	20
St. Louis, Mo..........	687,029	19
Boston, Mass..........	670,585	20
Cleveland, Ohio........	560,663	47
Baltimore, Md.........	558,485	10
Pittsburg, Pa..........	533,905	18
Detroit, Mich..........	465,766	63
Buffalo, N. Y..........	423,715	20
San Francisco, Cal.....	416,912	22
Milwaukee, Wis........	373,857	31
Cincinnati, Ohio.......	364,463	12
Newark, N. J..........	347,469	41
New Orleans, La.......	339,075	18
Washington, D. C......	331,069	19
Los Angeles, Cal.......	319,198	212
Minneapolis, Minn.....	301,408	49
Jersey City, N. J.......	267,779	30
Kansas City, Mo.......	248,381	52
Seattle, Wash..........	237,194	194
Indianapolis, Ind.......	233,650	38
Providence, R. I.......	224,326	28
Louisville, Ky..........	223,928	9
Rochester, N. Y........	218,149	34
St. Paul, Minn.........	214,744	32
Denver, Colo..........	213,381	59
Portland, Oreg.........	207,214	129
Columbus, Ohio........	181,548	45
Toledo, Ohio..........	168,497	28
Atlanta, Ga............	154,839	72
Oakland, Cal..........	150,174	124
Worcester, Mass.......	145,986	23
Syracuse, N. Y.........	137,249	27
New Haven, Conn.....	133,605	24
Birmingham, Ala.......	132,685	245
Memphis, Tenn........	131,105	28
Scranton, Pa...........	129,867	27
Richmond, Va.........	127,628	50
Paterson, N. J.........	125,600	19
Omaha, Neb...........	124,096	21
Fall River, Mass.......	119,295	14
Dayton, Ohio..........	116,577	37
Grand Rapids, Mich....	112,571	29
Nashville, Tenn........	110,364	37
Lowell, Mass..........	106,294	12
Cambridge, Mass.......	104,839	14
Spokane, Wash........	104,402	183
Bridgeport, Conn......	102,054	44
Albany, N. Y..........	100,253	7

OUR GREATEST CITIES

New York, our greatest city, has had a phenomenal growth for a great body of people. It has increased by nearly two-fifths of its population in 1900. Its increase was greater than in the decade preceding, caused, no doubt, by the greatly increased immigration in the last decade, a large proportion of which has remained in the city where it landed. In the past ten years it has added nearly one and one-third millions.

Its additions alone very nearly equal the combined total population of St. Louis and Boston, respectively the fourth and fifth cities of the country in numbers. The increase of New York equals that of Chicago, Philadelphia, St. Louis, Boston, Cleveland, and Detroit. Its population is a million greater than the combined population of Chicago and Philadelphia, the next largest cities. It contains more than half the population of New York State.

New York is exceeded in number of inhabitants by London only. As is well known, London is not a city, as the word is understood in this country. It is not a community with well-defined limits, under a single municipal government, but an elastic group of boroughs, some of which are united for one municipal function, others for another; thus, there is a group of boroughs combined to provide themselves with a common water supply, another group for police purposes, etc. The largest of these groups, the County of London, had in 1909 a population of 7,429,740, or half as many again as New York.

The third city in size, Paris, is less than three-fifths the size of New York, and the fourth city, Tokyo, is less than half as large. New York is larger than Berlin and Vienna together.

Our second city, Chicago, grew by no means as rapidly in the last decade as in that preceding, nor did it grow as rapidly as New York in the last decade. Still it added nearly 400,000 inhabitants. Philadelphia, which in recent times has been rather slow in growth, added only one-fifth to its numbers. St. Louis and Boston grew at about the same rate. Cleveland showed a phenomenal growth, slightly exceeding its rate for the decade 1890-1900, and raising it from seventh to

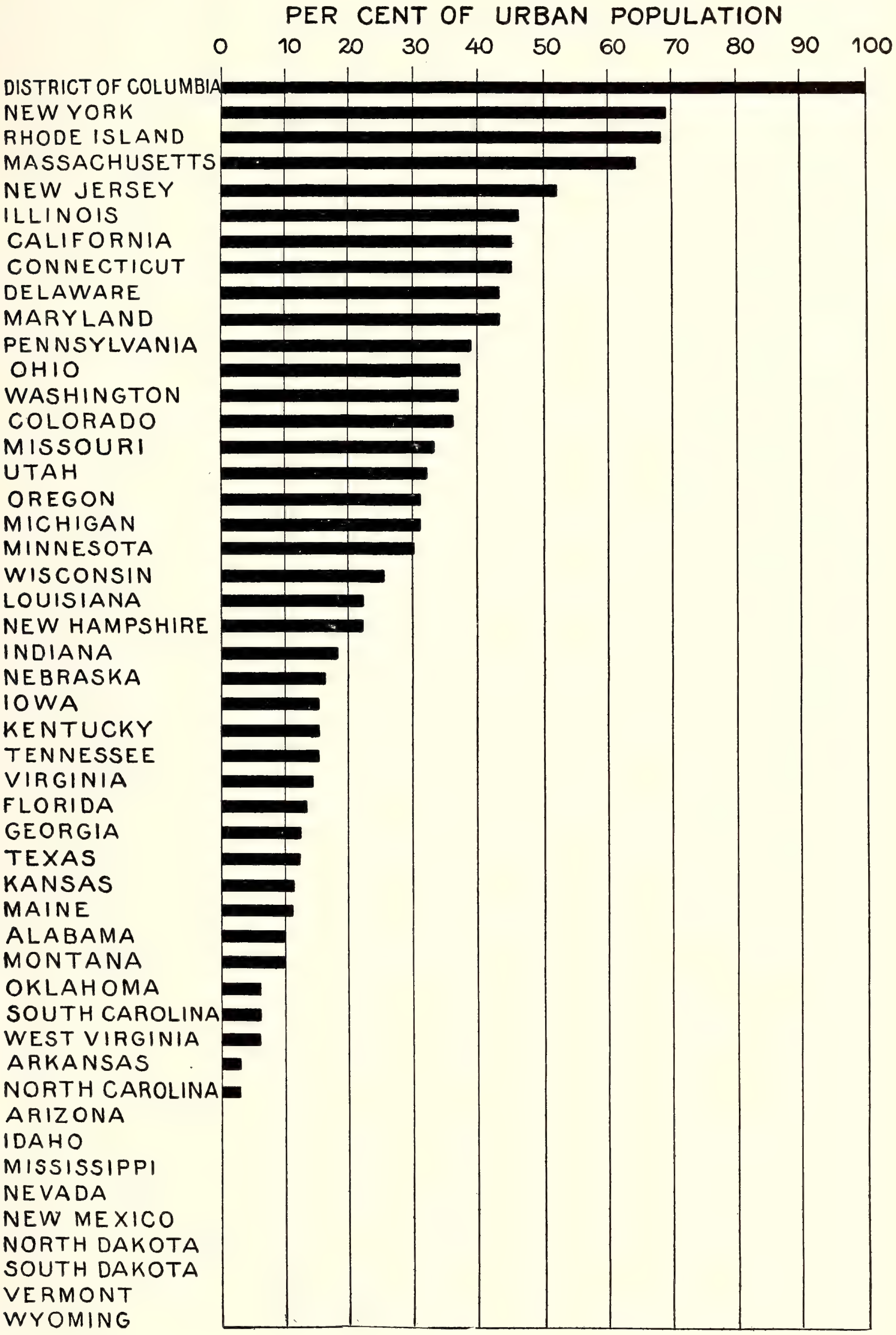


DIAGRAM TO SHOW THE PROPORTION OF THE POPULATION LIVING IN CITIES

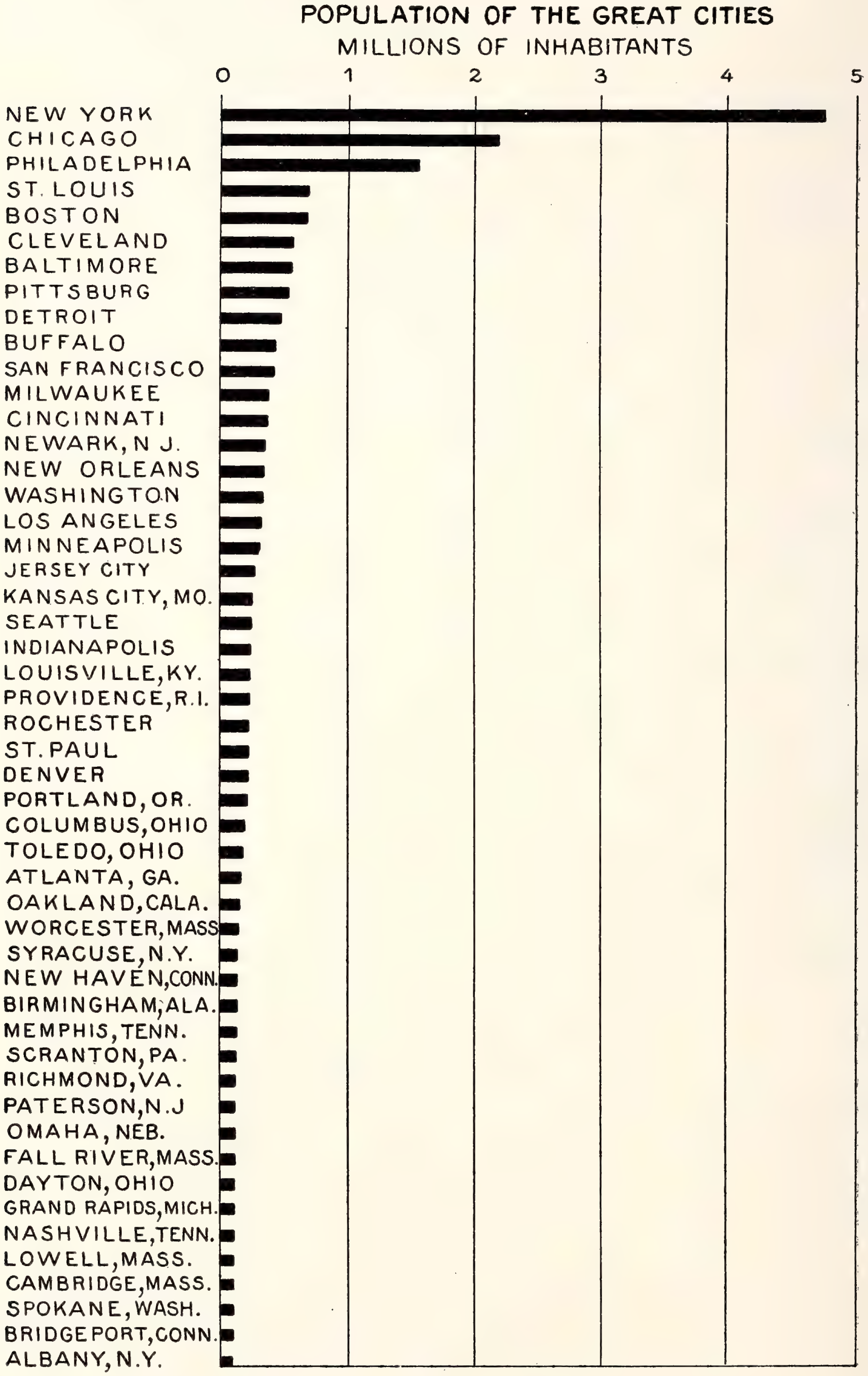


DIAGRAM COMPARING THE SIZE OF OUR GREATER CITIES

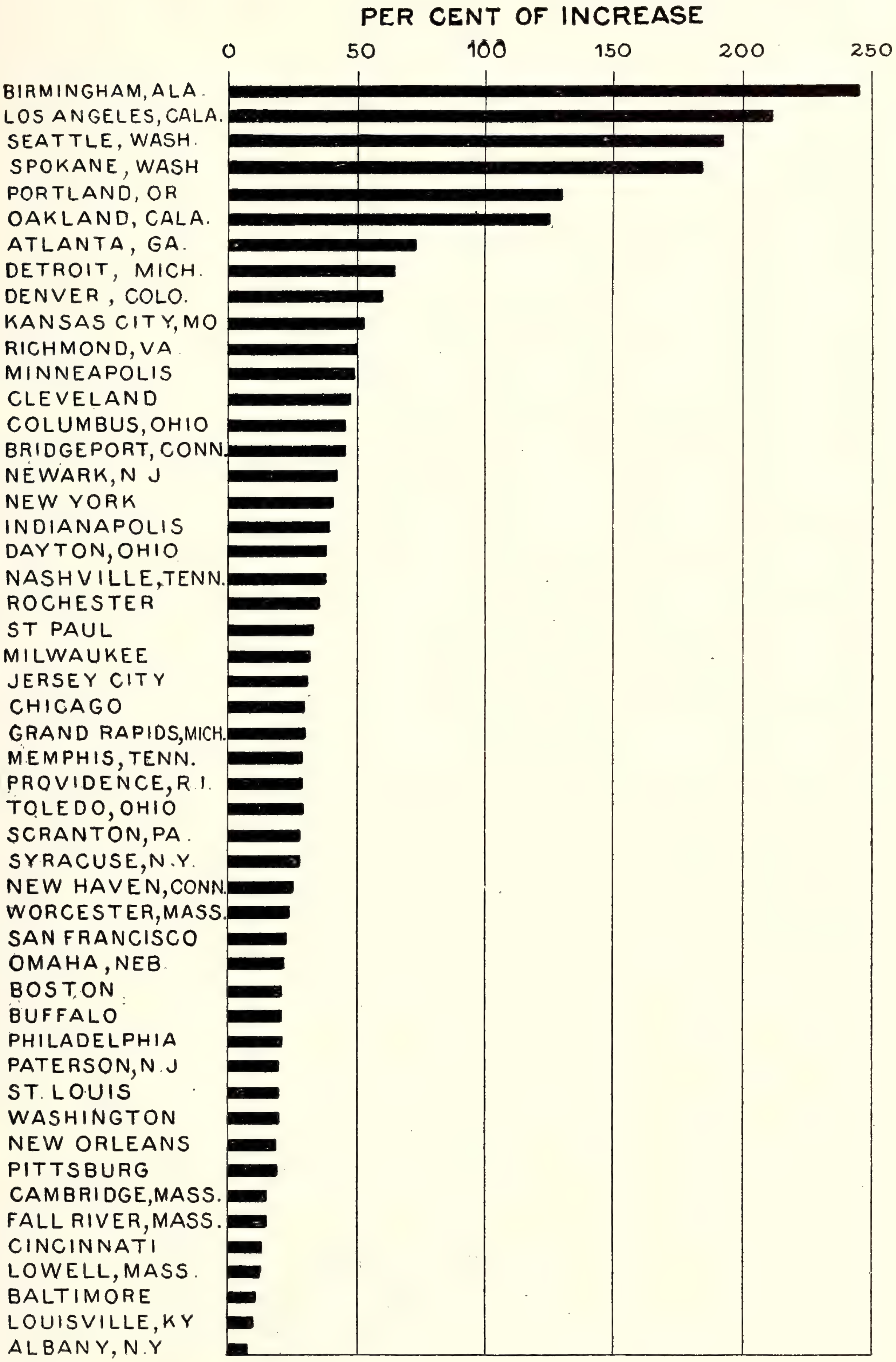


DIAGRAM TO SHOW THE RATE OF GROWTH OF OUR GREATER CITIES sixth place among our great cities. This is due to the rapid development of the iron industry, for Cleveland is the leading place where the iron ore from Lake Superior meets the coke from the Pittsburg region.

Baltimore showed a slow growth and was forced out of sixth place by Cleveland. Pittsburg has not grown as rapidly as was expected of our leading iron center. The chief growth has occurred in the boroughs surrounding Pittsburg, in Allegheny County, which nearly doubled in population in the decade. If Pittsburg were to extend her corporate limits to include these boroughs, she would contain nearly three-quarters of a million people, and would be the fourth city of the country in population.

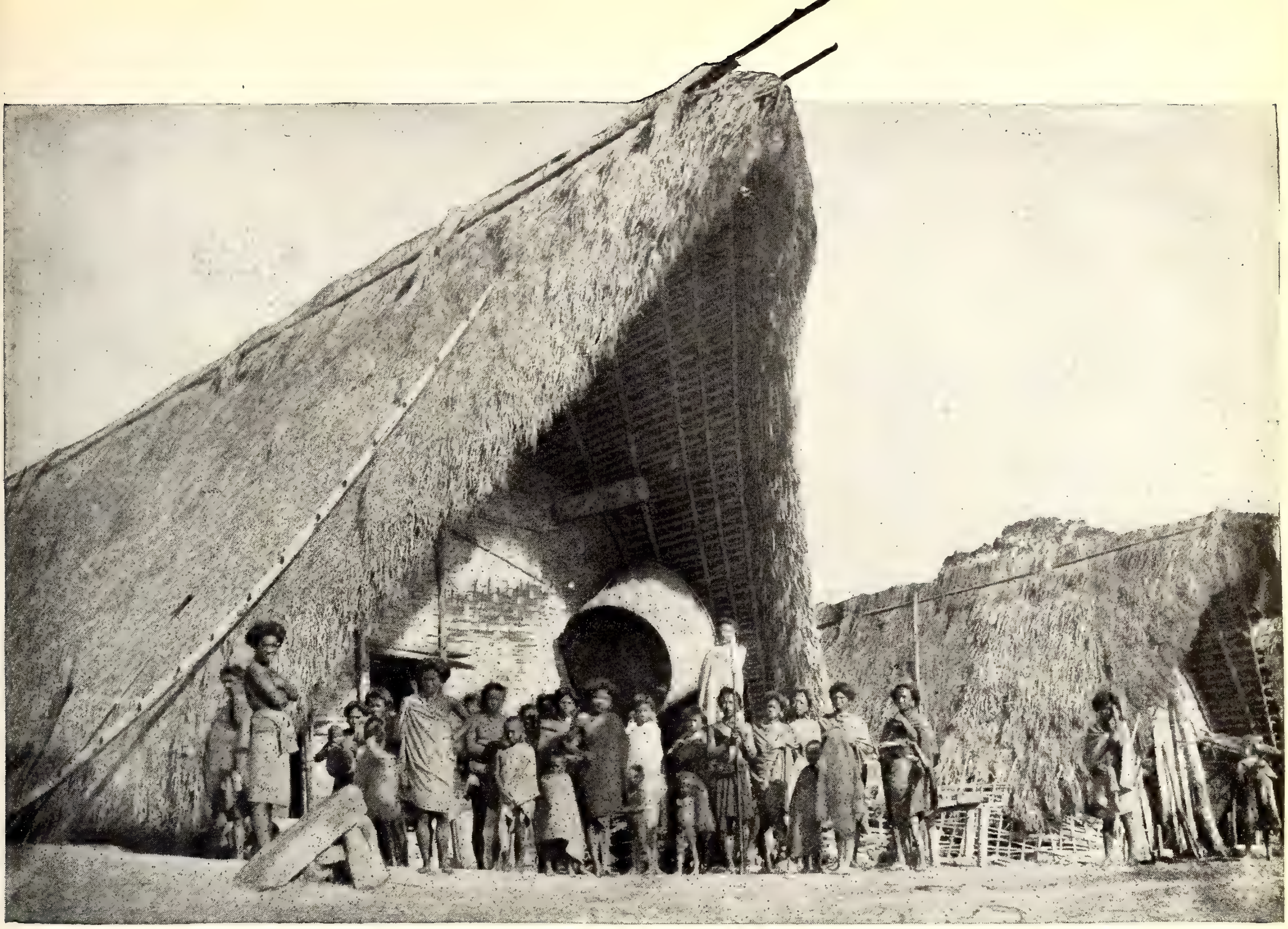
Detroit has grown at a tremendous rate, and has come up from thirteenth place to ninth. This is owing mainly to the development of the automobile industry, of which it is perhaps the largest center. The growth of Buffalo is at first sight disappointing, but the towns between it and Niagara Falls, its suburbs, have grown enormously, owing to the development of power from Niagara Falls.

The case of San Francisco is a marvelous one. Destroyed by earthquake and fire only four years ago, it has rebuilt itself, and has not only held its population of ten years ago, but increased it between a fourth and a fifth, while the cities across the bay have grown at almost fabulous rates.

Indeed, the cities of the west coast have grown tremendously. Los Angeles has more than trebled its numbers; Seattle and Spokane have nearly trebled theirs, and Portland has much more than doubled hers.

Of all the cities of the country, however, Birmingham, Alabama, has made the most startling strides. In 1910 it contained nearly three and one-half times as many people as in 1900. Its progress is due, as is well known, to its iron manufactures. Atlanta, Georgia, another city of the South, has had a great growth.

INDIANS AT CUZCO, PERU: WOMAN WEAVING ON NATIVE LOOM



HUT OF THE CHIEF, OR HEAD MAN, OF A NAGA VILLAGE (SEE PAGE 55)

The large basket suspended from the projecting roof is used for measuring grain. Photo from "Women of All Nations," Cassell & Co., New York, by courtesy of Mrs. Frank Wilde

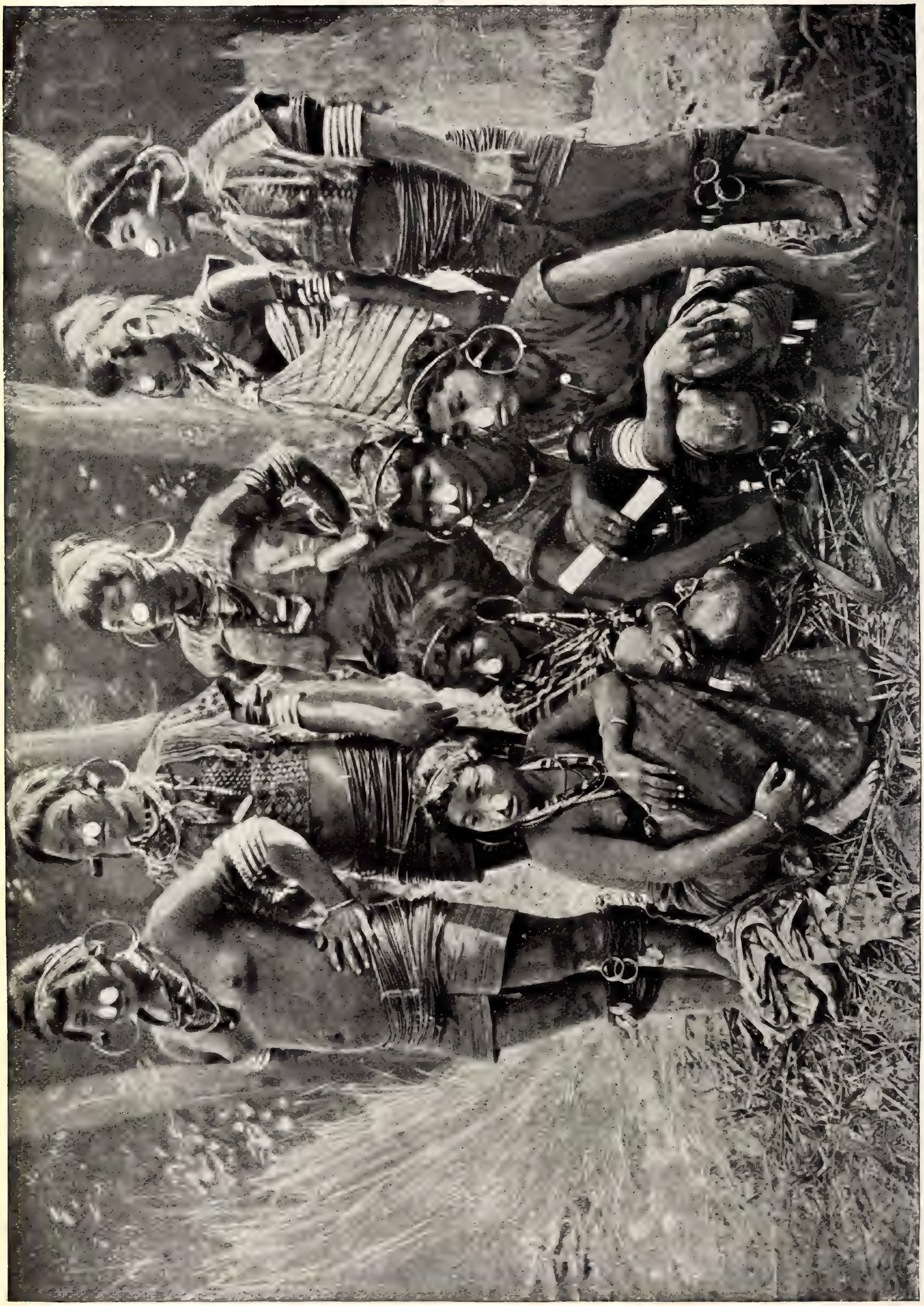
WOMEN OF ALL NATIONS

The following article is abstracted from a fascinating work recently published by Cassell & Company, entitled "Women of All Nations—their characteristics, habits, manners, customs, and influence," in two very profusely illustrated volumes. The editors of the book, T. Athol Joyce and N. W. Thomas, Fellows of the Royal Anthropological Institute of Great Britain, were assisted by 20 eminent authorities. The late O. T. Mason and Walter Hough contribute the chapters on the Eskimo and North American Indians; Clive Holland describes the women of France and of Japan; Mrs. Frank Wilde, the unknown peoples of Assam; Miss Ella C. Sykes, the ladies of Persia, and other well-known writers who have written chapters are Lady Ramsay, Annette M. B. Meakin, Alice Werner, W. W. Skeat, Theodor Koch Grunberg, and A. R. Colquhoun.

SINCE man rose above the lowest grade of savagery, if not ever since the world began, woman has been the theme of poets, the model of artists and sculptors, and the despair of the male sex generally.

Taking a broad view of history, we may say that in one aspect it is the story of how woman has ceased to be the slave of man, as she is among the peoples on the lowest planes of culture, and has become his helpmeet.

European taste looks chiefly at beauty of form and feature, and, other things being equal, color—be it black, brown, or red—does not obscure the perception of



NAGA WOMEN FROM THE PATKOI HILLS: ASSAM (SEE PAGE 55)

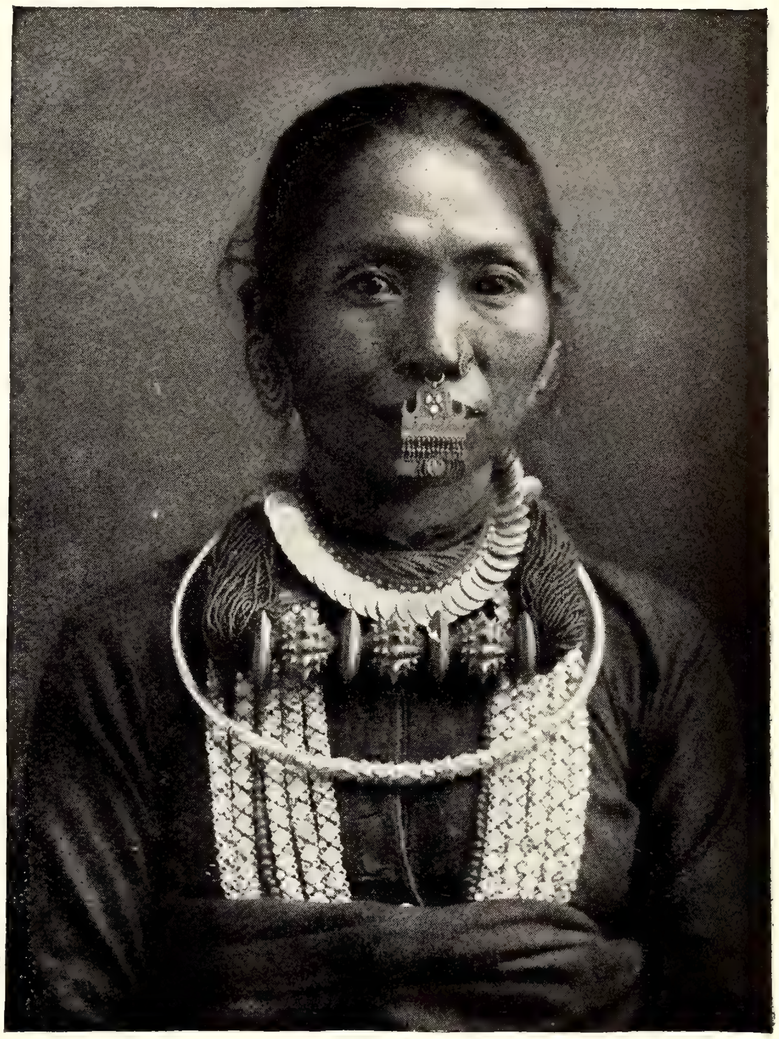
These women were employed in carrying rations for the staff engaged in a survey of these hills. Photo from "Women of All Nations," Cassell & Co., New York, by courtesy of Mrs. Frank Wilde it; but savage races, especially when they come in contact with European women for the first time, often complain that their sickly hue is not to their liking, and commiserate them. *Das ewig Weibliche* apparently ceases to be attractive if it is too far from the type to which man is accustomed.

STRANGE IDEAS OF ADORNMENT

"A woman without ornament is like a field without water," runs the Eastern proverb; and, in spite of the fact that the Maoris of New Zealand urge that, "though a woman be ever so plain, men will still run after her," the female sex throughout the world is never averse to add to its personal charms by adventitious aids.

At the same time it must not be thought that among savages are to be found the choicest and most elaborate toilets, at least as far as the ladies are concerned. Within certain limits it is true to say that the lower we descend in the scale of civilization the more nearly the human race is found to approximate to the brute creation, in the fact that it is the sterner sex which is the more brilliantly ornamented. Under the conditions of latter-day civilization, of course, the position is reversed, and the varieties of feminine adornment quite eclipse the somber garb of a mere man, the uniforms of the "services," the coats of huntsmen and golfers, and the ties and waistcoats of undergraduates forming rare exceptions. The most primitive form of ornament consists in the attempt to alter the form of the body in order that it may approximate to some ideal of beauty; and, as ideals vary from tribe to tribe and from people to people, this attempt is made in divers ways.

To take a few examples: In Persia, among some of the Turkish and Moorish peoples, and certain African and South American tribes, the ideal of feminine beauty is found in excessive embonpoint, and the women in consequence suit their diet to the fashion. Among certain of the inhabitants of the northwest coast of America, a retreating forehead is essential to true beauty, and the heads of infants are deformed by means of a special appliance fixed to the cradle, so that they may acquire the requisite slope from nose-tip to crown. In some localities in South America tight bandages are worn below the knee in order to produce a swollen calf, and many tribes in Africa employ artificial means to elongate the breasts.

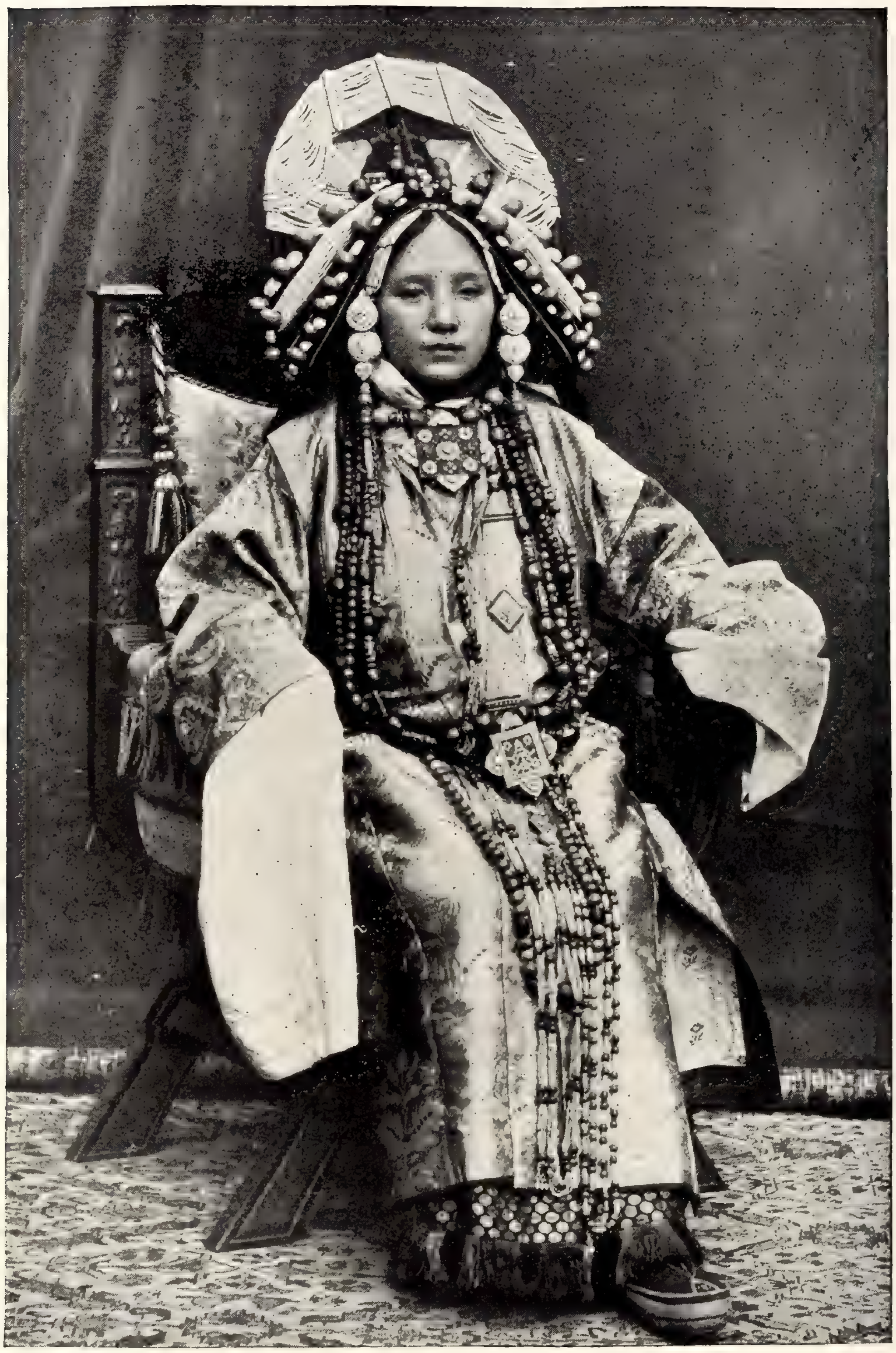


A WOMAN OF NEPAL, OF MONGOLIAN TYPE

The jewelry is silver, gold, and glass beads. The large beads are of carved wood. Photo from "Women of All Nations," Cassell & Co., New York, by Johnston & Hoffmann.

Polynesian mothers mold the noses of their children to prevent them from growing prominent. The Tahitians frequently said to the missionary Williams, "What a pity it is that English mothers pull the children's noses so much and make them so frightfully long."

In China the feet of the women are so

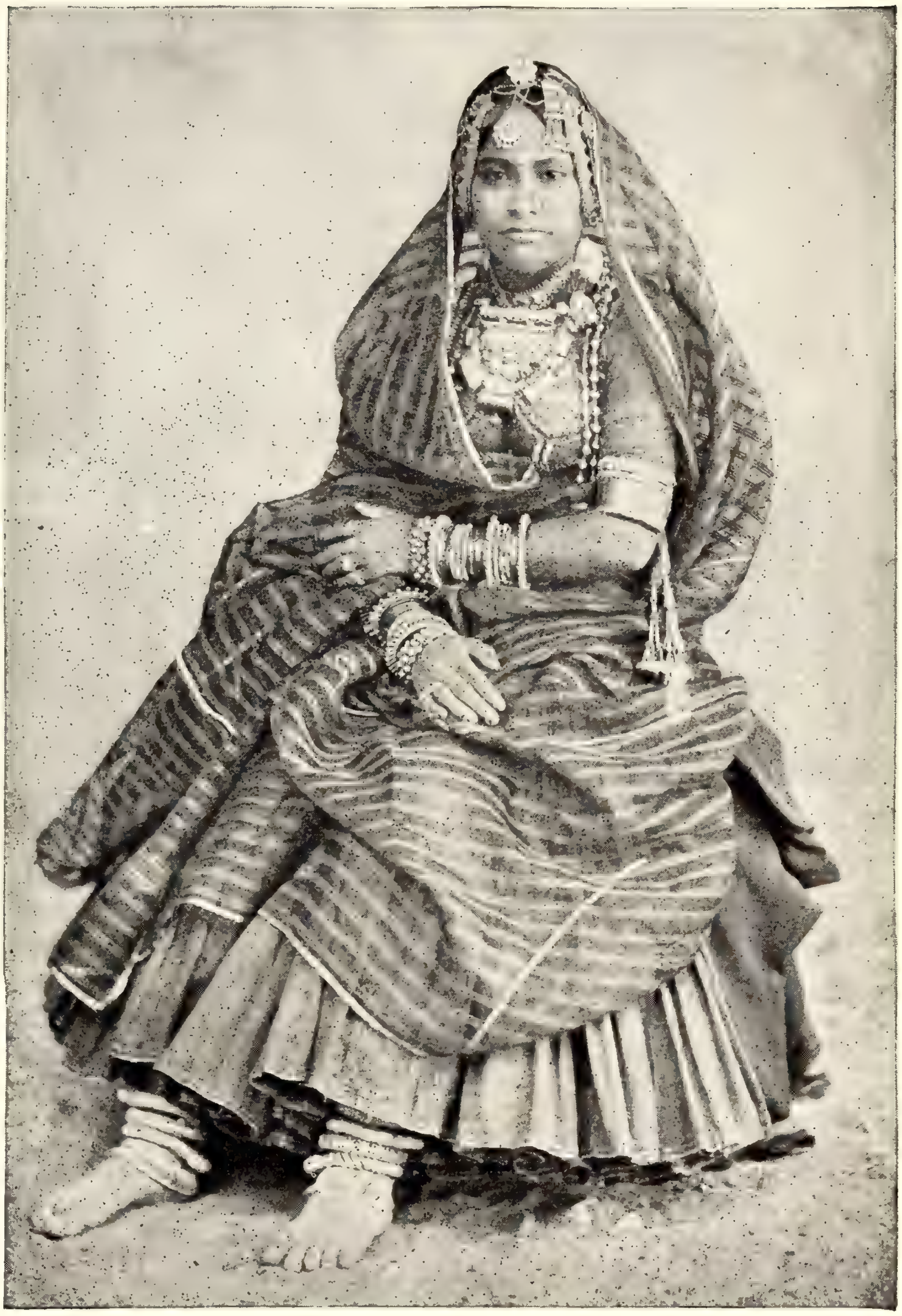


THE RANI OF SIKKIM (SEE PAGE 60)

Her head-dress is composed chiefly of pearls. Her ear-rings are of turquoise. The necklaces are of carnelian, turquoise, gold, and glass beads. Her dress is of the richest brocade. Photo from "Women of All Nations," Cassell & Co., New York, by Johnston & Hoffmann.

compressed as to be practically useless; but, though this sacrifice to fashion must be exceedingly irksome, it is not in reality fraught with such serious consequences as the waist compression practiced by their "civilized" sisters in modern Europe.

The fundamental object of such aids to beauty was näively admitted by a Chinese girl on whom a lady missionary was trying to impress the folly of foot-bandaging: "Me squeezy foot; you squeezy waist; all same what for, get husband."



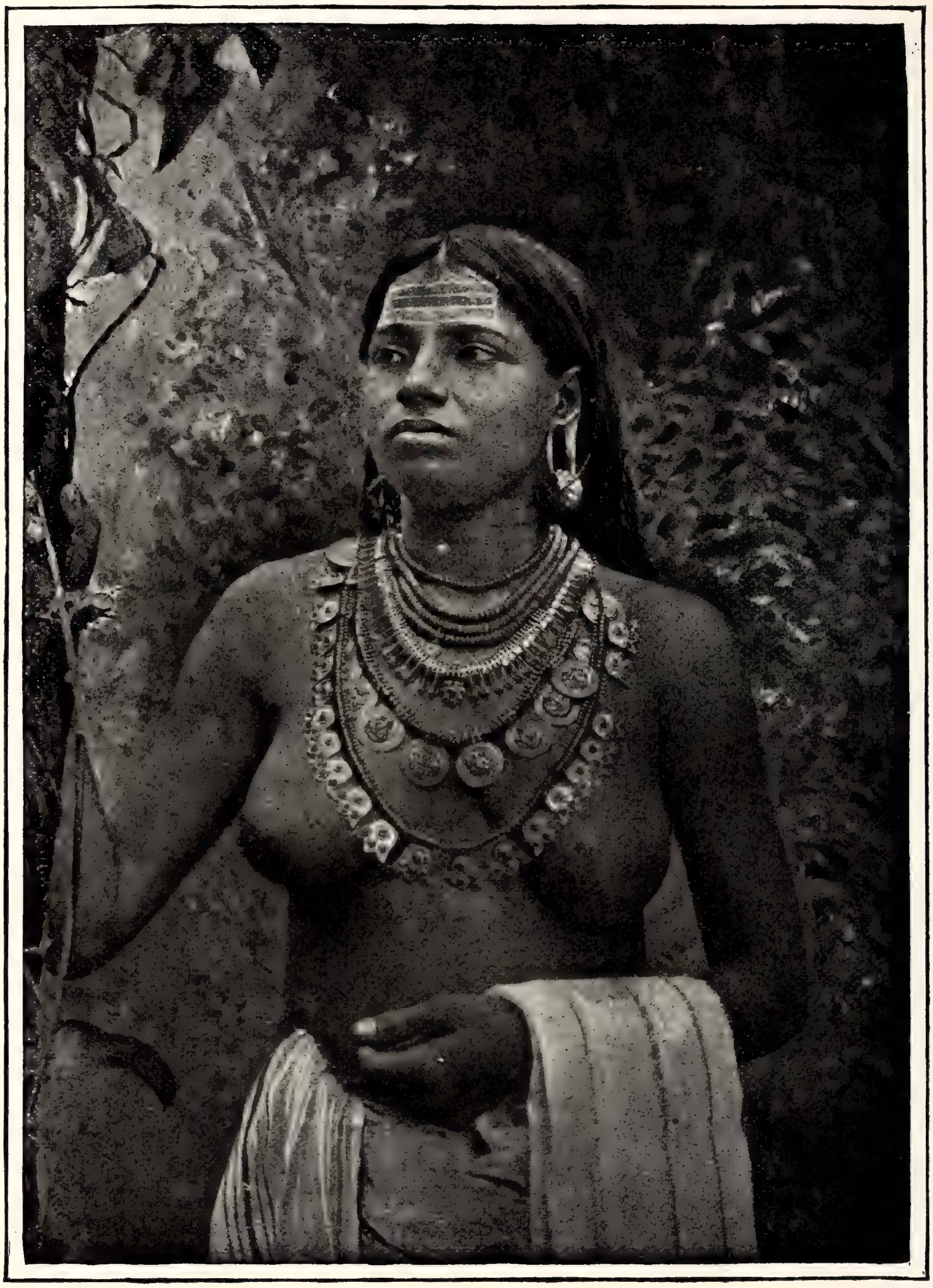
A MARWARI LADY, WIFE OF A RICH BUNNIA (MONEY-LENDER) (SEE PAGE 61)

She is loaded with jewelry. The gold cylinders on her necklace contain amulets and charms to keep away disease. Photo from "Women of All Nations," Cassell & Co., New York, by S. Narayan.

Painting the body as a form of ornament is another primitive aid to beauty, and is correspondingly widespread, especially in savage America. Frequently in Africa and Australia it is a sign of mourning. The commonest colors are red, yellow, white, and black, obtained from various kinds of ochre, powdered wood, lime, and charcoal. The familiar rice powder is found in Java; in Tibet many devotees of fashion adorn their cheeks with a fascinating mosaic of starch and seeds, while the Chinese use the starch only. Further "aids to beauty" are the *lac,* applied to the teeth of the women of the southeast of the Asiatic continent, and the *henna,* employed by Oriental ladies to color their nails and hair.

A more permanent form of coloration is found in the tattooing practiced by many of the fairer races, among whom may be mentioned the Maori, whose women ornament the chin in this fashion; the Ainu, by whom a coquettish little mustache tattooed on the upper lip is considered essential for women of fashion; the Algerians, and the Chukchi of northeast Siberia. Among the duskier peoples—in whose case this form of ornament would not be very apparent—incisions are made in the skin, the healing of which is retarded so that prominent scars result, which form intricate patterns on the parts of the body so ornamented. This custom is widespread in Africa, especially among the Congo tribes.

When we come to speak of the multitudinous objects worn on and around the body and limbs, their variety at first seems to baffle all description; but a short consideration elicits the fact that there are very few which have not their counterpart in the highest European circles. There is not, after all, a very great difference between a necklace of diamonds and one of teeth, each in its appropriate surroundings. The live birds carried in



DRAVIDIAN NAMBURI BRAHMAN LADY OF THE WEST COAST OF INDIA IN FULL DRESS

Her ornaments are of gold, and form the only covering she is allowed to wear above the waist in public. Photo from "Women of All Nations," Cassell & Co., New York, by Nicholas & Co.

the ears of New Zealanders have their parallel in the fireflies worn by Central American beauties and the live tortoise attached to the girdles of fashionable Parisiennes. It will be sufficient to say that the savage belles enhance their charms by all the armory of "jewelry" known to their European sisters. There are, however, a few forms of ornament which the latter have outgrown, and these are perhaps worthy of a few moments' consideration.

One of the little pygmy ladies who lately visited London had her upper lip pierced in three places, and often wore small brass rings through the punctures.

Exaggerated forms of this species of ornament are found among some tribes of British Central Africa, where the women wear large plugs of wood or ivory in the upper lip, distending the latter to an extent which, to European eyes, is hideous in the extreme. Similar large lip-plugs, but in this case worn in the lower lip, embellish the features of certain tribes in northwest and South America, while smaller ones are found among the Eskimos. The last named, as well as some South Americans, wear discs of this kind in the cheeks.

The nose, again, is frequently the support of an ornament of some sort. In New Guinea, Australia, and parts of Africa and the Malay states, slender bars of wood or bone are worn through a hole in the septum, while the nose-ring and nose-stud are common in India, and the former among the Tartars.

CLOTHING AND MODESTY

From ornament we pass imperceptibly to the question of clothing; and, indeed, there is no real difference, in so far as the former has evolved out of the latter. We may even go further and say that it is not an innate feeling of modesty which has produced clothing, but clothing which is responsible for the feeling of modesty in man. We have only to look at a few of the non-European races to see how entirely conventional this feeling is, and how it differs in various parts of the globe.

The first care of a Mahometan woman surprised at her bath is to conceal her face; the Chinese lady would feel excessive shame at the uncovering of her foot; the Sumatran at the exposure of her knee, and a woman of a certain tribe in Africa would be terribly upset if the small twig at the back of her girdle should happen to fall off. Some Asiatics think it unseemly for a woman to show her finger-tips, and, in America, a woman of the northwest could not bear to be seen without her lip-plug, while a Carib beauty would far rather appear in public without her girdle than minus her paint.

Another instance of the conventionality of modesty is seen in certain aspects of Japanese life and ideas as compared with our own. Among this people the two sexes in some places still take their baths in common without finding the process at all awkward, yet the representation of the nude in Japanese art is rare and even considered improper. With us, of course, the reverse is the case. In few places in England is mixed bathing, even in full costume, allowed; yet the nude in art, thanks to classical traditions, is common and generally passes unchallenged.

THE NAGAS OF ASSAM, INDIA

Writing of the Nagas, Mrs. Frank Wilde says that 50 years ago they were savage head-hunters. The girls of this tribe would not marry a man unless he had heads to show as proof of his courage. Having slain an enemy, a warrior may wear a kilt decorated with cowrie shells. Collars are also worn, ornamented with cowries, tufts of goats' hair dyed red, and locks of hair from the heads of persons killed. Some tribes wear a curious wooden tail decorated with hard white seed and goats' hair. I have in my possession a Naga tail to which are attached long locks of human hair, which must represent the spoil from many a scalp.

Naga villages are built on inaccessible hills, or along a steep spur; their huts differ entirely from those of other hill tribes. They have high gable ends, and the roof slopes down and back until it nearly touches the ground. The eaves also almost touch the ground, as shown in the illustration on page 49. The hut is divided into three compartments. The large one in the center is used as a sleeping or living-room; the small division in front serves as a grain store, and here the women pound the rice for making the rice-beer, which is the favorite drink of the Nagas. It is made and stored in the small compartment at the back of the living-room.

Nearly all the Naga villages have a large hut which serves as a club and sleeping apartment for the bachelors, and not a few have a similar hut for the unmarried girls, which is presided over by

TAMIL COOLIE WOMAN ON A TEA ESTATE: CEYLON

(See page 61.) Photo from "Women of All Nations," Cassell & Co., New York, by Skeen & Co.

a widow or elderly female. In other villages the girls sleep together by threes or fours. Each hut has a platform jutting out over the hillside and commanding a view of the surrounding country. This was necessary in former days, when the villages were so constantly raided by warlike neighbors. The young women spend the day on this platform preparing the cotton yarn for weaving; the primitive hand-looms are tied to the house-posts; the girls sit on the ground and swiftly throw the shuttle backwards and forwards.

The villages are divided into wards, called khels. Each khel is a distinctive unit, and is ruled by a headman. Should one khel be attacked by another khel, the members of adjoining khels will calmly look on and never attempt to interfere, or even to defend the women and children. In one of the government reports a Naga, giving an account of a village fight, stated that one man, five women, and 20 children were killed. He described the killing of the children as rare sport, like the killing of chickens.

The women of some of the tribes living in the more remote hills wear circles of cane round their waist and strips of cane wound round their legs below the knees. The illustration on page 50 is from a photograph taken by the late R. A. Way, Esq., chief engineer in charge of a survey expedition in the Patkoi Hills. These women were employed in carrying rations. It was with great difficulty that they were persuaded to allow themselves to be photographed.

The Naga girls wear their hair cut short, but after marriage it is allowed to grow long. The girls wear necklaces of beads and shells; bracelets and anklets of brass, sometimes of silver. On marriage these are discarded. A married woman no longer joins in the dances; for her the serious business of life has begun, such as helping her husband in the village "jhoom," gathering firewood, and carrying water. The latter task is no light one, for the water supply is frequently 300 to 500 feet down the hillside, and the water is carried up a steep path in sections of thick bamboos. One wonders why, with so little inducement to marry, the Naga girls give up the

A NORWEGIAN GIRL SKI-ING

Photo from "Women of All Nations," Cassell & Co., New York, by A. B. Wilse, Christiania

freedom they enjoy as maidens. A widow inherits all her husband's property on the condition she does not remarry, and, at her husband's death, she is called upon to state whether or not she intends to do so! Should she retain the property and afterwards remarry, the case is arranged among the relatives, but formerly she was put to death by her husband's relatives.

Most of the tribes bury their dead, and in the funeral ceremonies a woman's basket and weaving-sticks are placed over the grave. The dead are buried either in the village street or outside the village bounds. In some tribes the corpse of a child or young girl is buried in the earthen floor of the house, and a pathetic reason for this custom was given to a government official by a Naga who had

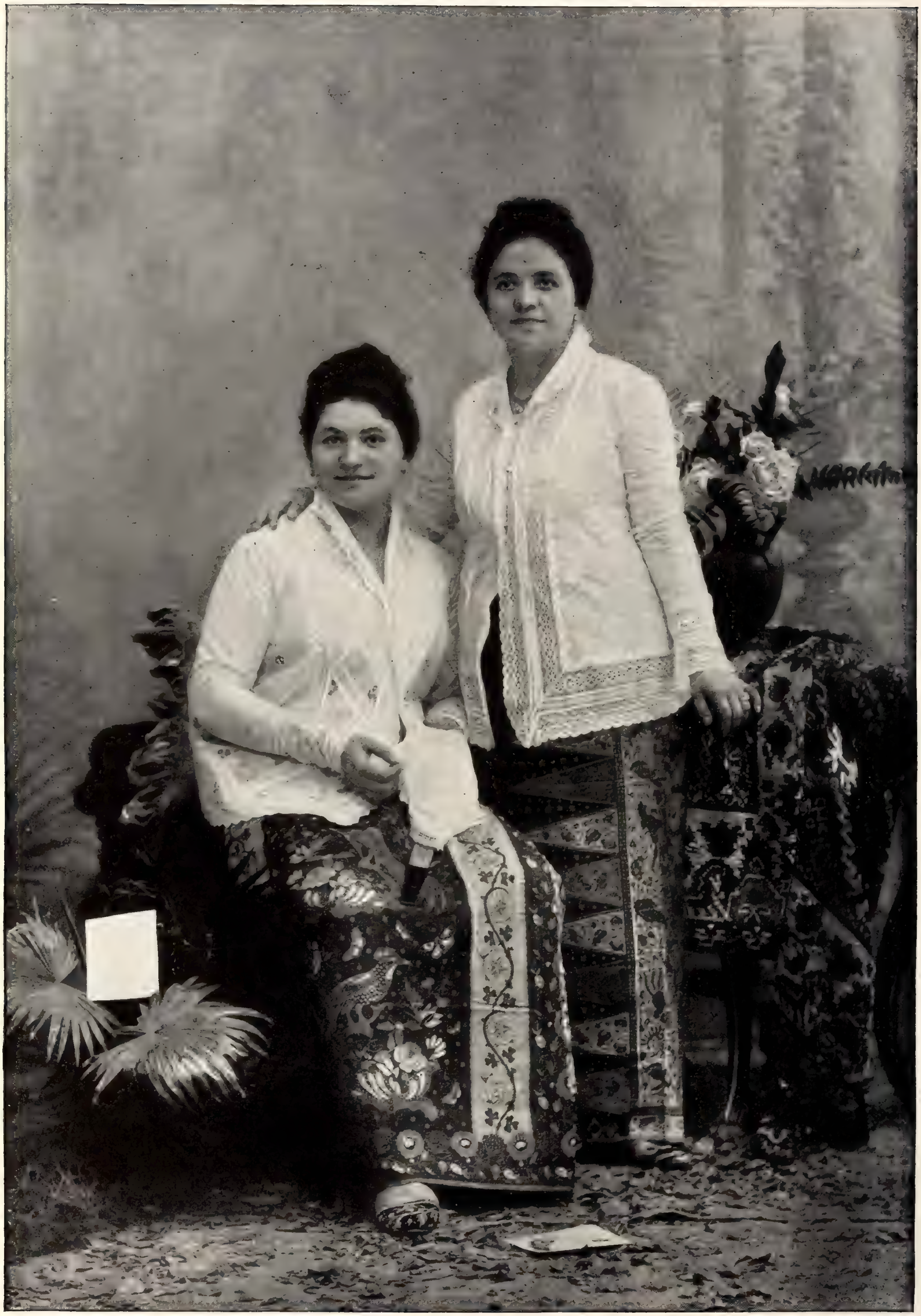


Photo from David Fairchild

LADIES IN THE COSTUME WORN BY THE JAVANESE IN THE DUTCH EAST INDIES

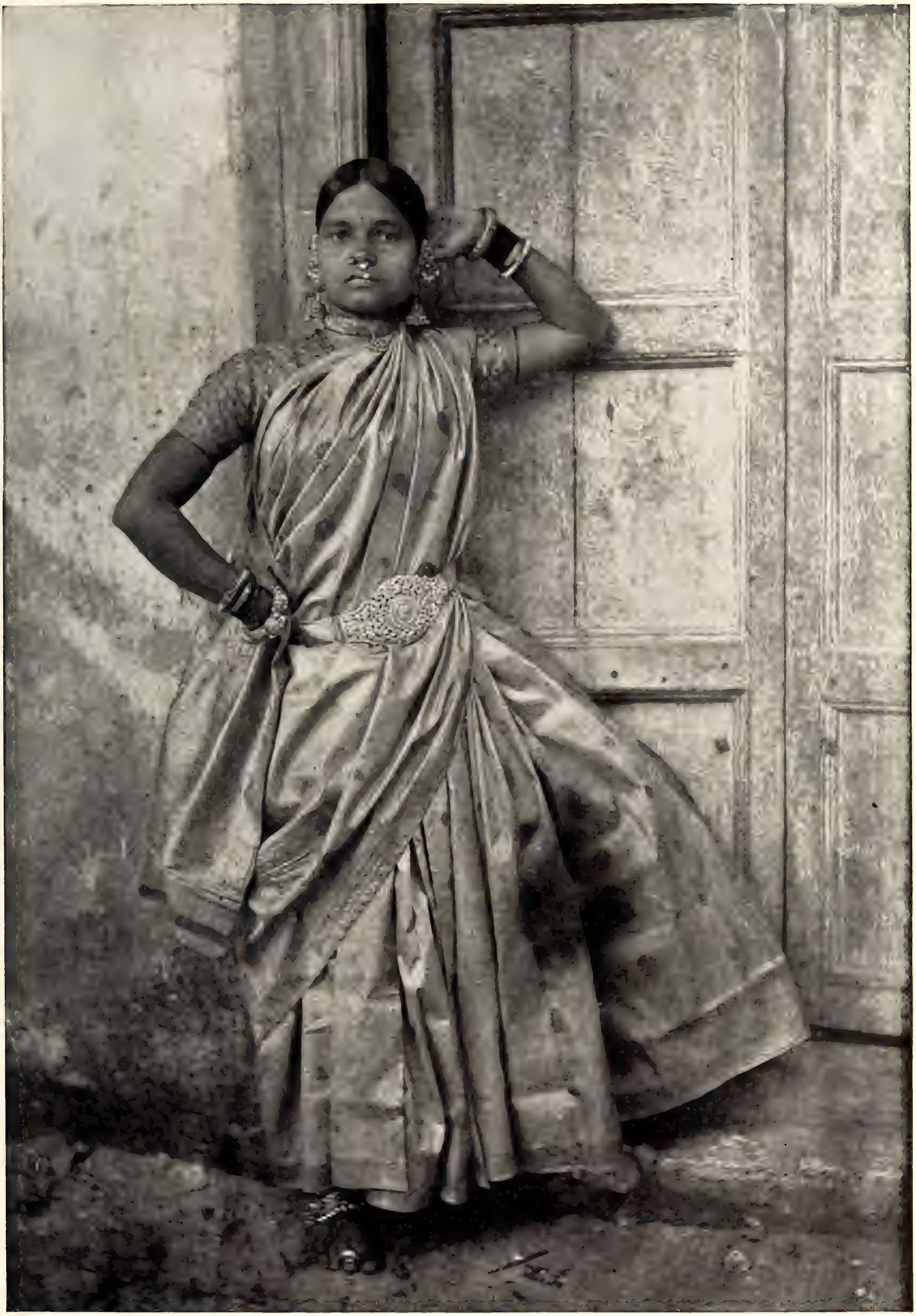


Photo from David Fairchild

BRITISH INDIAN GIRL BORN IN CEYLON

SAXON PEASANT GIRLS IN FESTIVE COSTUME

Photo from "Women of All Nations," Cassell & Co., New York, by courtesy of Amy A. Locke

just lost a young daughter: "She might be frightened if left out alone, with nothing but the sky above her at night."

SOME OF THE PEOPLE OF NORTH INDIA

India has become the home of many nations and many tongues; of many forms of religion and many degrees of civilization. On the one hand there are people who are justly proud of a civilization older than that of the nation by which they are governed; on the other there are tribes living in the forests who are as savage and uncivilized as the Polynesians.

In its geographical features the north of India presents every variety of form and climate. There is the plateau, where the blizzard rages in winter and the land is iron-bound in frost; the arid plain, waterless and sun-scorched; the snow-capped mountain, inaccessible to the hardiest mountaineer; the smiling valley, a veritable paradise to ease-loving humanity; the poisonous swamp and the dense forest, the home of the wild beast and deadly snake. Most extensive of all are the broad, level tracts of fertile land, which yield two crops a year to the industrious agriculturalist. In such a country there was room for a long succession of invaders without the extermination of the weak. Descendants of the different types are still to be found throughout the breadth of the land. They have adapted themselves to the climate and to the nature of the country in which they have settled, and consider themselves in every respect the inheritors of the land.

The Rani of Sikkim, a small state lying on the southern slopes of the Himalayas between Nepal and Bhutan, has the appearance (see page 52) of being a child of ten or eleven. The little figure is loaded with rich brocade and masses of jewels. There is no sign in those placid features that she is discontented with her lot, or that she has any thought of a different life. She has the greatly admired wheaten complexion, an olive tint that is common in the south of Europe. Her hazel-brown eyes are darkened on the lower lids to heighten their beauty. Her lips are reddened, and her skin, from seclusion and the use of cosmetic oils, is as smooth and soft as satin.

Of a different type altogether are the Marwari ladies (see page 53). The Marwari is a merchant and money-lender, known as a bunnia. He is a dealer in corn, in which commodity he makes "corners." The jewels worn by the women indicate the lucrativeness of the trade. There are bunnias all over India, and the trade is not confined to one caste. By religion the Marwaris who come from Marwar and Guzerat are Jains. The Jains of the present day venerate the cow, employ Brahmans in their religious rites, and worship at Hindu temples. In some of its features Jainism bears a resemblance to Buddhism, but it rejects the doctrine of Nirvana. The preservation of life in every form is an article of the faith. It has led to the establishment of animal hospitals called pinjrapoles. The unfortunate creatures that find an asylum in these institutions would be happier dead. They are ill-fed and ill-cared for.

Particularly striking, says E. A. Crawford, are the women of Ceylon. Most travelers east of Suez touch at Colombo, and are more or less familiar with the brown faces, regular features, and deftly coiled long hair of the crowds thronging its quays and streets. Perhaps many also have shared the mistake of the English lady who wondered why so many more women than men walked abroad in this Oriental city. She soon discovered that the round tortoise-shell comb, to us reminiscent of little girls of mid-Victorian period, is reserved exclusively for male persons, and that the adornment of long hair and petticoats is shared by men with the gentler sex. So, of the seeming feminine crowd, maybe all are males.

The immigrant Tamils, especially on the up-country tea estates and south and west of Ceylon, are of the coolie caste, so that few Tamil ladies are usually met with. There are, however, some who, in good looks, charm of manner, and education, need not fear comparison with their European sisters. Their dress is rich and effective, and they are loaded with costly ornaments in their ears, round their neck, in their hair, and across the forehead, and also round their arms, wrists, and slim ankles. The toes, too, are decorated with rings, and the wing of the nostril is pierced to receive a jewel.

Amongst the population of immigrant Tamils who cultivate tea and other products in the hill country of Ceylon, large numbers of women and children of the coolie caste are employed chiefly to pluck the leaf and care for the bushes. One sees them dotted over the steep hillsides during the sunny hours, each with a large but light basket strapped to the back. The mothers arrive on the field with their babe across their hips, and, leaving them to slumber or kick about, innocent of garments, under the shade of a tea-bush near, proceed to fill their baskets with the glossy leaves.

The Tamil mother brings her elder children to help in the plucking, and all day the family is out of doors, happy in the fragrant sunshine. It is an existence that may well be envied by struggling workers in murky cities. Perfect air, congenial labor, and freedom from care, on five shillings a week for a paterfamilias!

Ceylon is a kind of El Dorado to the dense population of the southern part of the Madras Presidency, whence the coolies (or laborers) arrive in crowds, often miserably emaciated. They soon fatten on prosperous Ceylon, and invariably return to their "coast," as they call the continent of India, in better circumstances, and not seldom purchase the coveted bit of land which is the summit of their ambition.

DAMASCUS, THE PEARL OF THE DESERT

By A. Forder, of Jerusalem

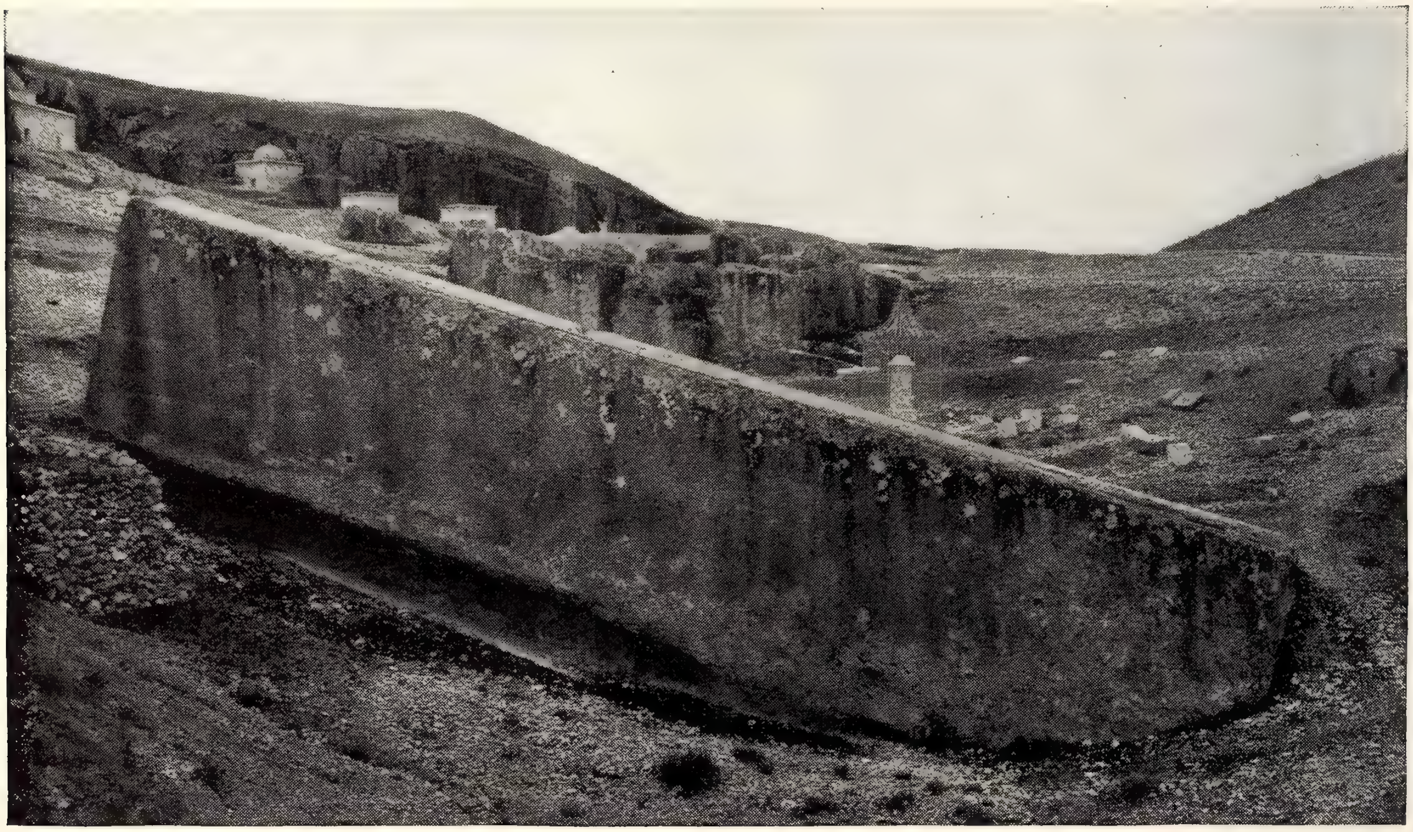
With Photographs by the Author

LEBANON and Damascus! How far back such names seem to carry us in the history of the world! Millenniums ago Damascus had its attractions for the Oriental, and today there is no city in the East that so charms Arab and Turk. The Bedouin from the sandy stretches of Arabia and arid Syria has given it an appropriate name in "The Pearl of the Desert"; for, with its thousands of white houses, mosques, and towers, encircled with miles of orchards and gardens, each vying with the other in foliage, the city indeed has a very charming appearance.

Damascus dates back to the time when the Pharaohs ruled in Egypt, and is one of the few cities of the Orient that has had a continuous history and existence.

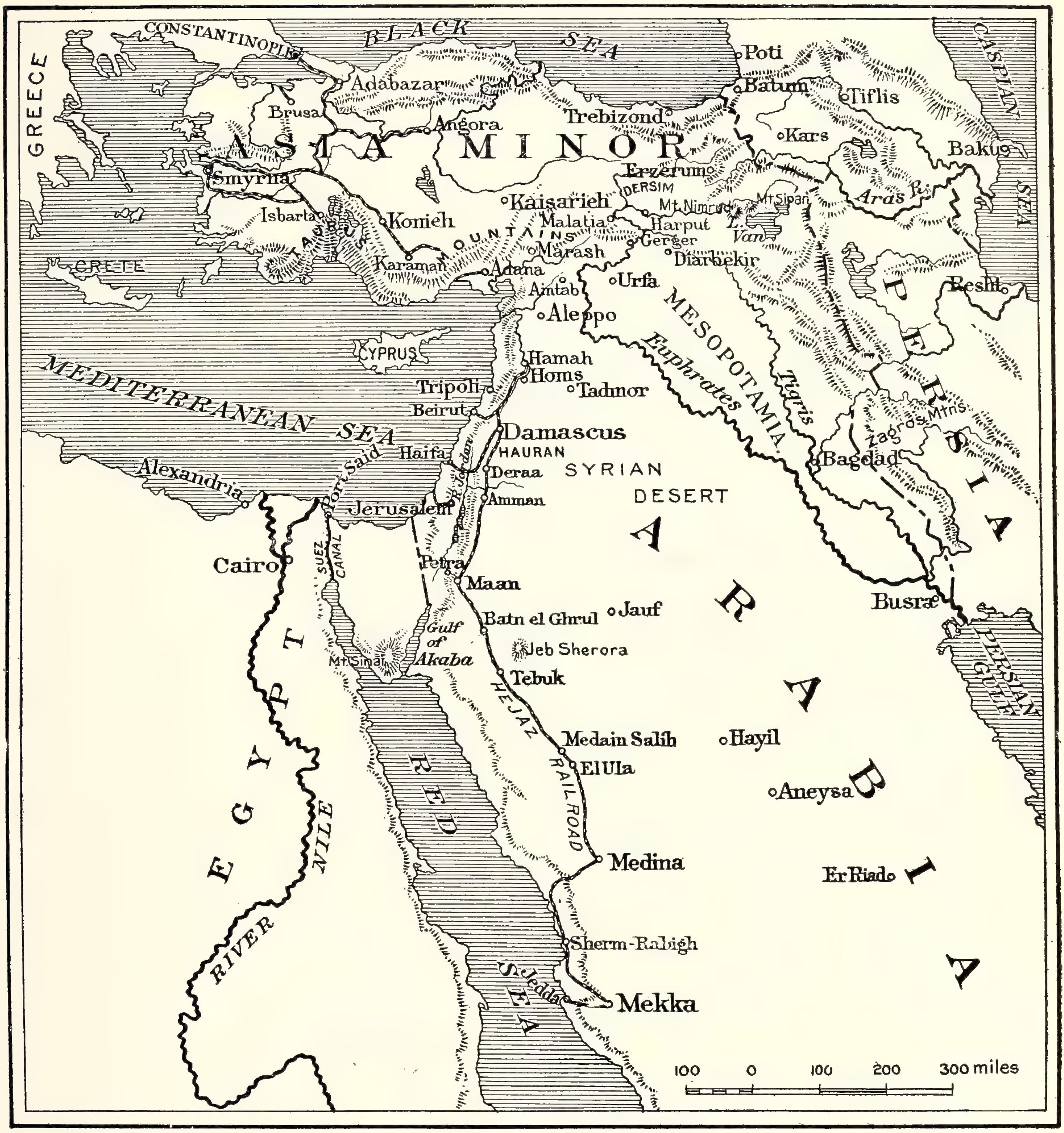
This city, which is second in importance in the Turkish Empire, may now be reached by three different railroads, thus making it a very attractive resort for the trader from all parts of the East, whereas a few years ago it was difficult of access. Its population is estimated at about some two hundred thousand souls, not including the garrison of many thousand soldiers. Despite the mixture of nationalities and creeds, the temper and endurance of the inhabitants is remarkable, for one never reads or hears of riots or impending trouble in Damascus.

The main and most used road to Damascus is the railway from Beirut, the principal port of Syria. This line is a narrow gauge rack-and-pinion system, crossing the mountains of Lebanon at a



THE MONOLITH OF THE LEBANON

This is the largest known stone ever quarried. It is 72 feet long, 17 feet 2 inches square, and is estimated to weigh more than a thousand tons. For some unknown reason it was never finished (see page 65).



MAP SHOWING LOCATION OF DAMASCUS

height of 4,880 feet above sea-level. Few have any idea that hidden away among the mountains are sights and scenes to excite the admiration of even the most disinterested; but, in order to see them, the comfort of the train has to be left and a number of miles covered in the saddle.

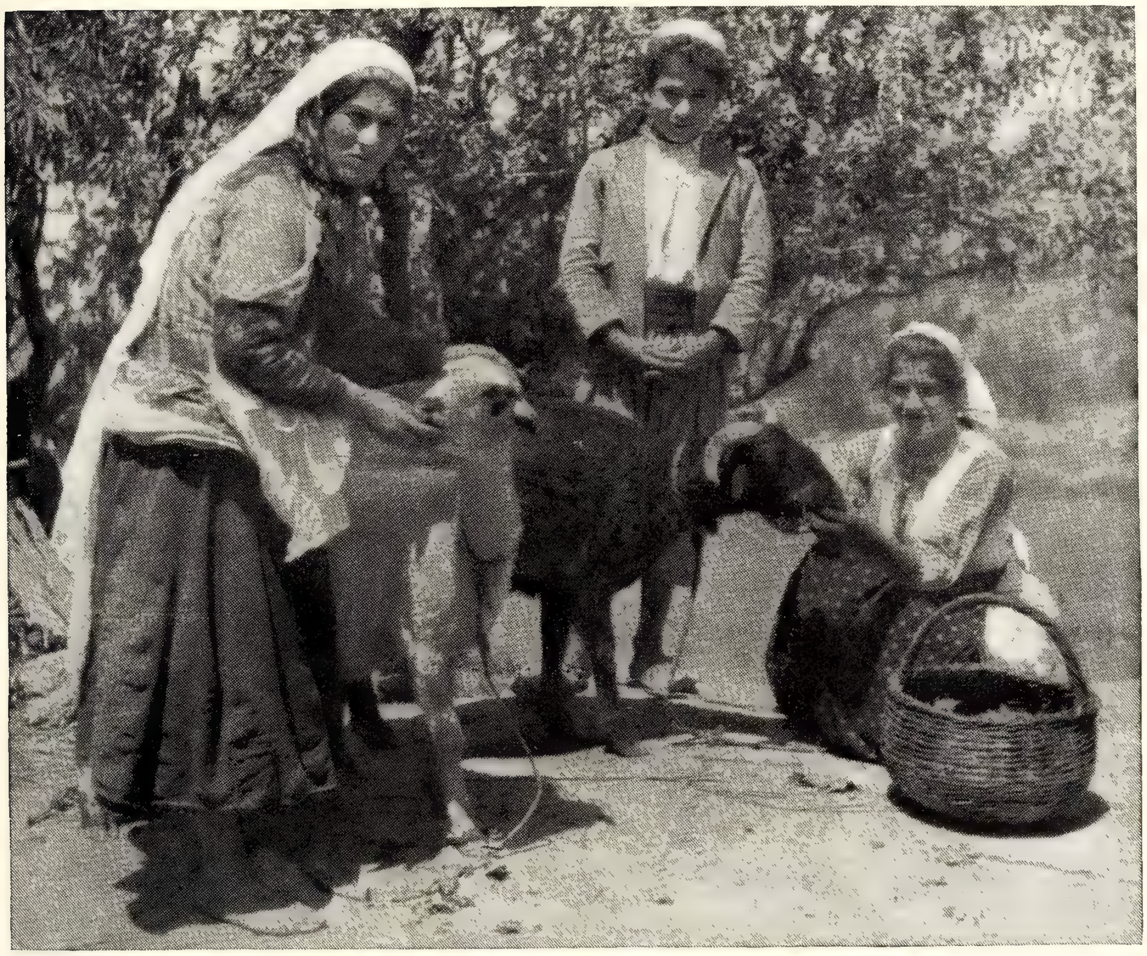
The railroad, built by the French, at times runs through some very fine scenery, and the entire journey of 90 miles is a constant panorama of mountain, forest, or plain.

At different points scattered in the mountains are to be found groups of cedar trees which until recent years suffered so severely at the hands of the natives that they were fast disappearing; but lately the government has placed guards at the various groups to prevent any more devastation. The largest group of these ancient and interesting trees is

SCENE ON THE BEIRUT-DAMASCUS RAILROAD

The line runs through deep valleys, forests, and mountain torrents and round the edges of precipitous cliffs, and is a fine piece of engineering skill. During winter traffic is frequently stopped by heavy snow-drifts.

to be found at Besherry. Here on an elevation are about 400 trees, the highest of which does not exceed 80 feet, while some are from 30 to 40 feet in circumference. By reason of heavy snows these trees can only be reached during the months of summer, when crowds of natives make merry under the pleasant



PROVIDING FOR THE WINTER

The sheep is coaxed to eat in order to increase its fat, so that the family may have sufficient grease with which to saturate their food during the winter months (see text below)

shade afforded by the spreading branches of these monarchs of the mountains.

The district of the Lebanon also carries the palm for having in its borders the largest stones ever quarried in the known history of man, for high up in the walls of an old castle in the ruins at Baalbek may be seen stones that are nearly 65 feet long and 15 feet square, while in an old quarry a mile away is a solid block of stone that measures 72 feet long and is 17 feet 2 inches square, the probable weight being considerably more than a thousand tons.

To what period these stones belong, or what race of giants hewed such massive blocks, or by what means they were moved from place to place and hoisted into position we have yet to learn, for from the absence of inscriptions the handlers of these almost immovable loads seem to have been content to pass off the stage of history unknown.

Were a visit made to the homes of these mountain people, there would be much of interest, for the raising of the silk worm and the subsequent silk harvest gives occupation to the majority of the men and women in the many villages. One thing is worthy of note, viz., all the eggs for the silk worms are brought yearly from France by men who are sent especially for the purpose. For some reason the eggs that are produced the previous season do not mature in the mountains; hence the necessity for importing from Europe.

In every home throughout the mountains may be seen women and girls compelling an already too satisfied sheep to swallow a little more of the green food that has been gathered off the hillsides or purchased from some near-by garden or mulberry plantation.

This pet lamb, subject to frequent bathings, is being fatted to provide savory dishes through the long and severe winter that faces the native. Dur-

ONE OF THE BESHERRY GROUP OF GIANT CEDARS

These trees, once so much in demand, are slowly declining in number, beauty, and value, as no one is responsible for their care or cultivation. They might be grown by the thousand and a large business so built up.

ing the month of November the fatted sheep is killed and cut up into mincemeat and melted in its own fat, to be used as a relish and sauce with the boiled rice or wheat that forms the staple dish of these hardy people.

Should occasion require, the fatted sheep may be killed to provide a feast for some unusual event, and in this custom there may be a perpetuation of the "fatted calf" of the Gospel. Hours are spent by the women and girls coaxing food down the throats of these overfed sheep, and toward the close of their existence they are so fat that they are unable to stand.

In some parts of the Lebanon the earth lends itself to the art of making pottery, and thousands of the natives get a livelihood by the manufacture of all kinds of earthenware vessels. Hidden away in the corner of his one-room house, the potter turns his wheel just as did the one to whom the ancient seer was commanded to go in the adjoining country of Palestine. From this primitive machinery comes many a vessel that for shape and form would do credit to the most skilled workman of the Occident. From the wheel the pottery is taken to be dried in the sun, then handled by the women, who do their best at decoration by painting all kinds of designs on the jars ere they are consigned to the furnace to be baked.

After the baking they are sold to traders, who transport them on muleback to all parts of the country, both east and west of the Jordan, to be sold or bartered for what we would think a ridiculously low price, but what enables many a man from the proceeds to retire and leave his sons to turn the wheel.

Unfortunately emigration to the United States has drawn away the flower of the Lebanon, and the pottery industry is in danger of becoming a thing of the past unless the sons of the land realize that there are fortunes in the clay of the mountains of their native land as well as the factories of America.

But the Lebanon contains natural beauties and wonders that equal if not surpass those of other lands. There is a remarkable natural bridge that has a span of 125 feet with a river 75 feet beneath it. This bridge has been formed by the running of the waters of centuries from the melting snows on Jebel Sennin, which rears its head 8,000 feet above sea-level and is "monarch of all

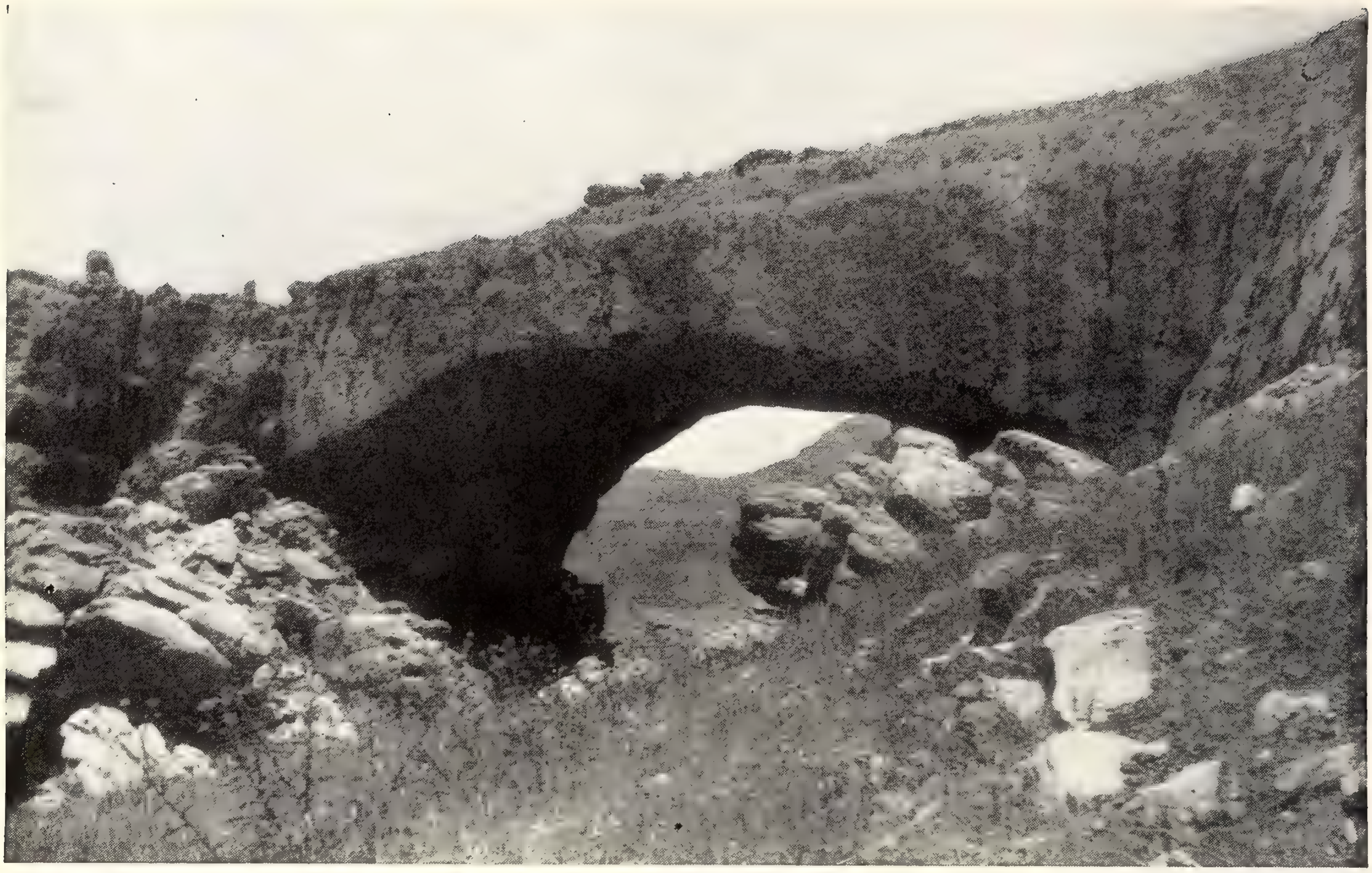
A POTTER AT THE WHEEL: DAMASCUS

A familiar scene in many of the homes of the Lebanon. Where such work is done each member of the family takes some share in preparing and bringing the clay to the wheel, on which it is skilfully molded into all kinds of vessels.

it surveys" in the Lebanon. Over the bridge is a constant stream of traffic, for it is one of the main roads through the mountains. The native has no eye for its wonder, and the traveler from the West rarely crosses it.

Another charm of the Lebanon is the abundance of cold, clear spring water. One is led to wonder why the Creator has been so lavish with the life-giving fluid in the Lebanon, while lands near by languish for want of it. Everywhere cascades, streams, springs, and waterfalls abound, sometimes to such an extent as to cause serious alarm and danger to the native and his property, but the finest fall of water in the mountains is to be seen at Afka, far away in the east, and requiring a long ride in order to reach it.

Out from a huge cavern high up in the cliffs rushes a strong flow of water, which comes tumbling down over the rocks into the valley below, in its course forming one of the finest waterfalls to be seen in all the Orient. In a land where water is so precious, it is no wonder that crowds of people resort there for many weeks during the long, hot



THE GREAT NATURAL BRIDGE OF THE LEBANON

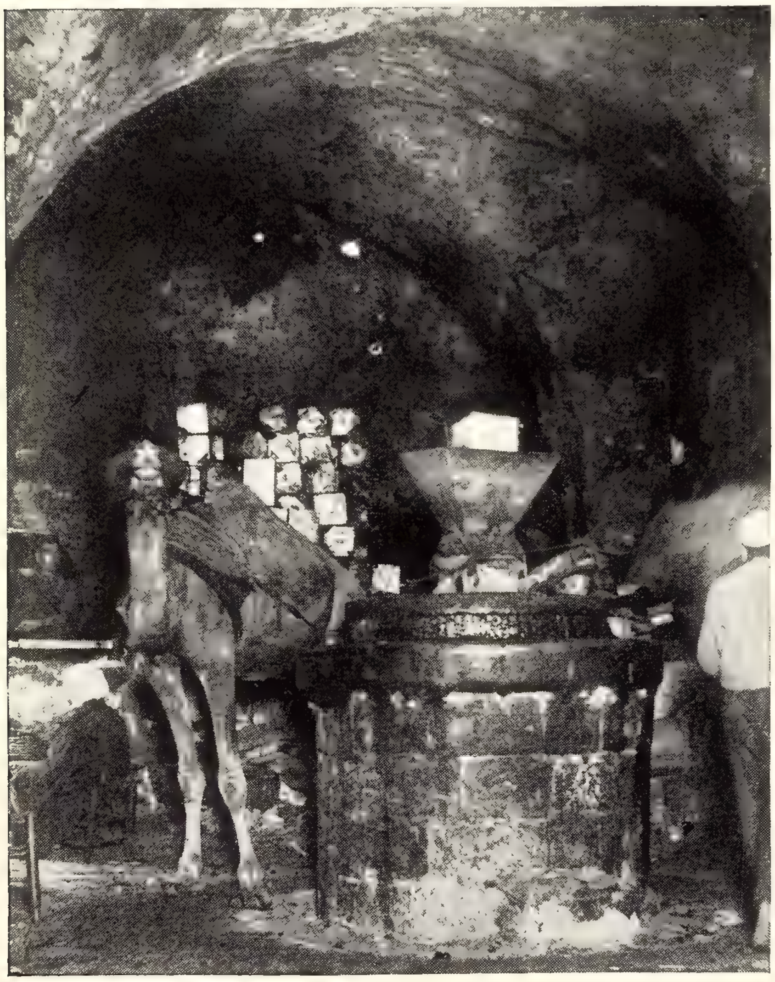
This nature-made crossing has a span of 125 feet, and 75 feet beneath flows a good stream of ice-cold water that springs from the mountains half a mile away (see page 66)

months of summer. It may be interesting to those versed in mythology to know that this fall and spring are connected with the myth of Venus and Adonis, and on a spot not far away are the remains of a temple to Venus which was destroyed by the Emperor Constantine because of the indecencies practiced there.

But we must not tarry longer over the charms of the Lebanon, but hasten to the city that lies under the shadow of its hills.

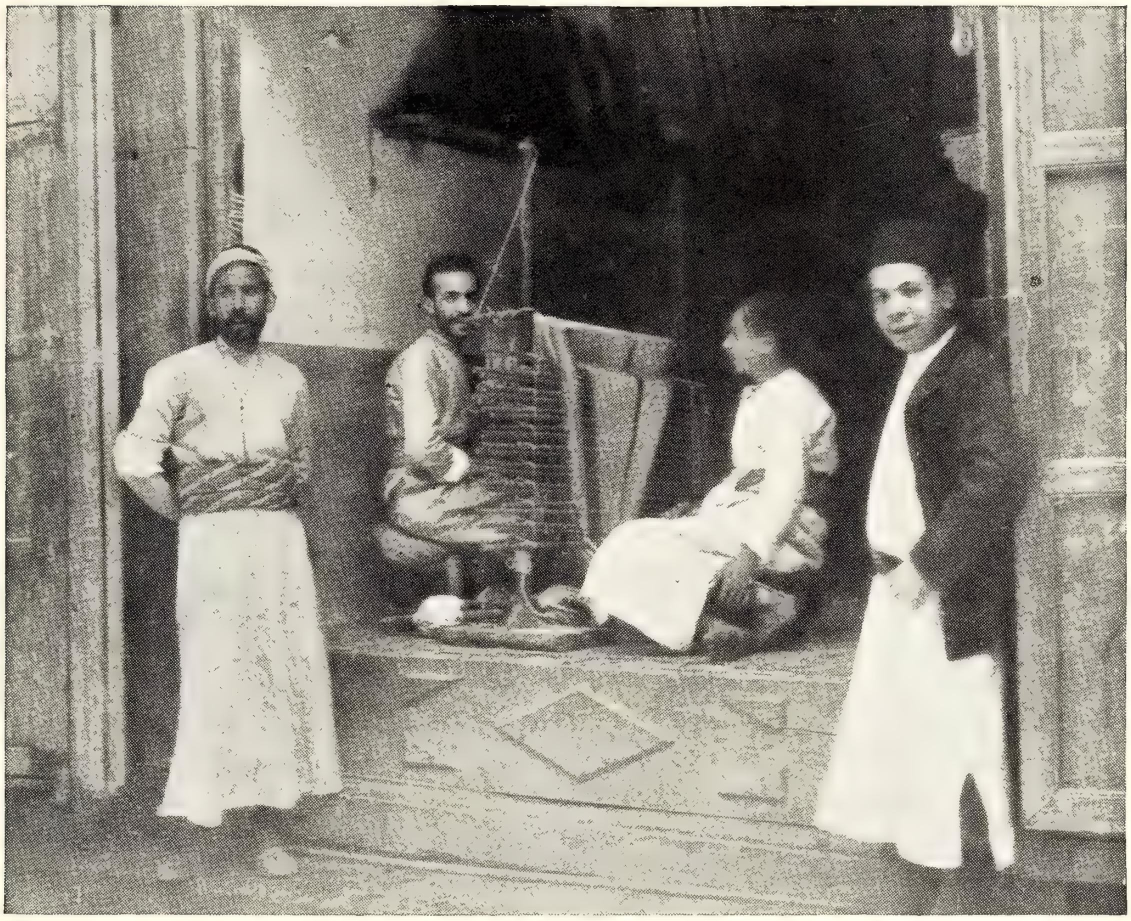
Damascus, as already stated, is the capital of Syria, and is the rendezvous of peoples from all parts of the Mohammedan world. It is one of the sacred cities of the followers of him who, having seen the city from the back of his fiery steed, requested that "as he had to enter paradise but once, it might not be in this life, but after he had passed out of it into the future state."

One cannot be long on the streets of Damascus without being interested in the motley crowd of humanity that swarm its streets, and, in spite of creed and nationality, manage to keep sweet-tempered.



A PRIMITIVE BUT EFFECTIVE MILL: DAMASCUS

A camel takes the place of steam to revolve the heavy stones that crush the grain or berries for which the mill is used. The camel is blindfolded so that it may not become giddy by its many revolutions. A difficult photograph to secure, taken with a flashlight.



STREET SCENE IN DAMASCUS

A weaver at his loom making curtains or cloth, which will be exported to Europe and sold at a high price. Thousands of men and boys are constantly employed in this manner; their daily wage is about 12 cents.

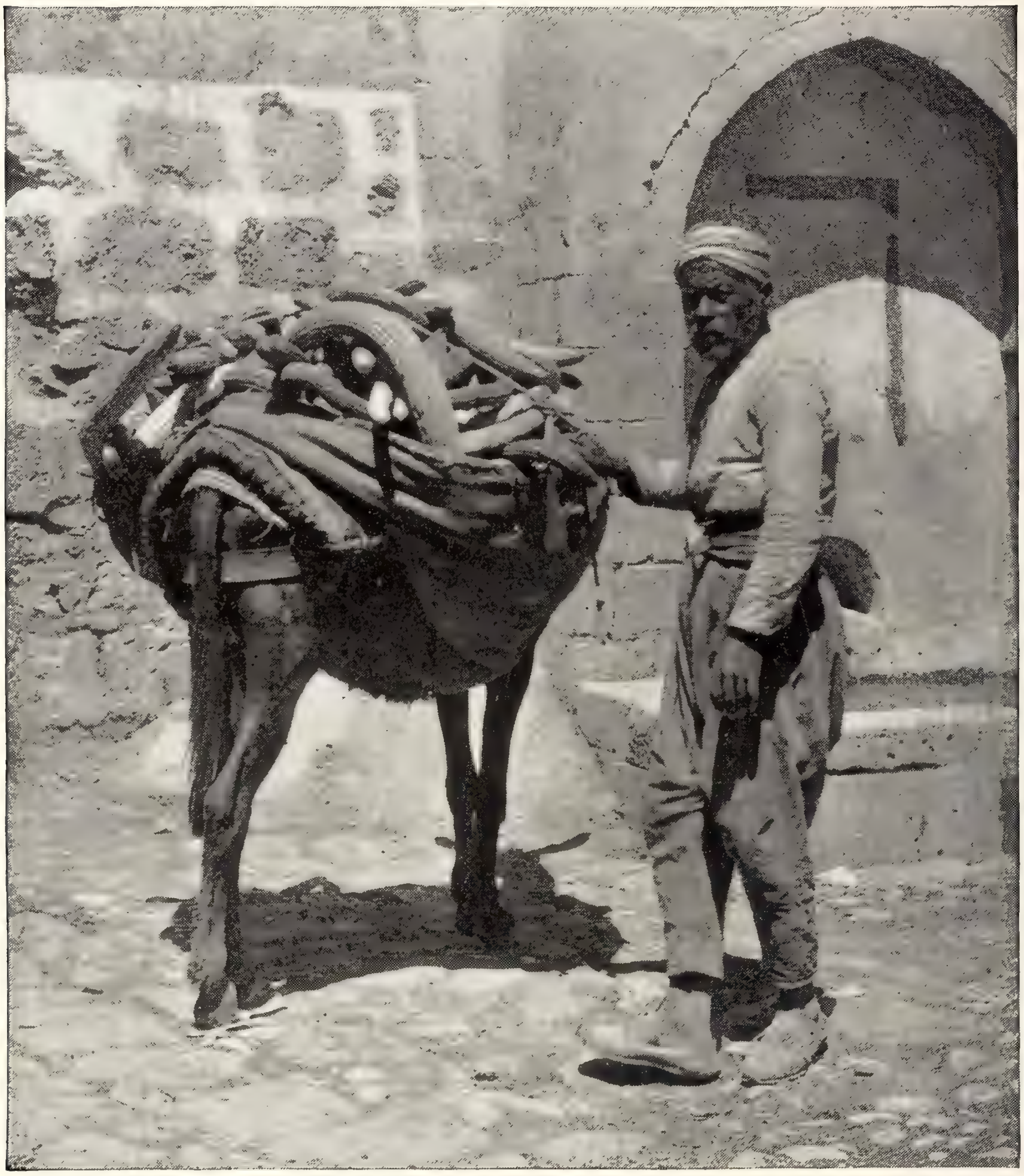
The spick-and-span Turkish officer fresh from Constantinople rubs against the swarthy, sunburnt son of the desert without even a word of scorn or anger; the Mohammedan shoulders the Jew as if they were brothers in the faith; the spotless visitor from the Occident jostles the not-any-too-clean peasant from the surrounding villages, while Persians, Moors, Afghans, Indians, Egyptians, Sudanese, and others from many parts of the globe hurry along, all intent on something of importance that has brought them to this metropolis of the Orient.

If you turn aside into the spacious bazaars you are compelled to stop and watch the many kinds of trades that give occupation to all classes of the Damascenes. Be it said to the credit of the city that very few idle people are seen in the streets, and the absence of beggars is noticeable, for work is no disgrace in Damascus, and the boys of the city form no insignificant part of the machinery that is responsible for the enormous amount of merchandise produced and exported from the town.

In different streets may be found together the shoe-makers, iron-workers, saddlers, carpenters, bakers, confectioners, drapers, silk merchants, grocers, stone masons, gold and silver smiths, druggists, and many others, all engaged in their different callings, and those of a mechanical turn of mind are invited to watch the worker at his calling without being badgered to buy his wares—a curse in almost every other Oriental city.

On the streets are to be seen venders of almost everything under the sun, especially in the way of eatables, and, to those who are familiar with the value of the goods offered for sale, the words of the native visitor are plain when he informs you that "in Damascus you can sup or breakfast for nothing," because of the little cost of food.

On the same street, within a few yards



AN INEXPENSIVE LOAD

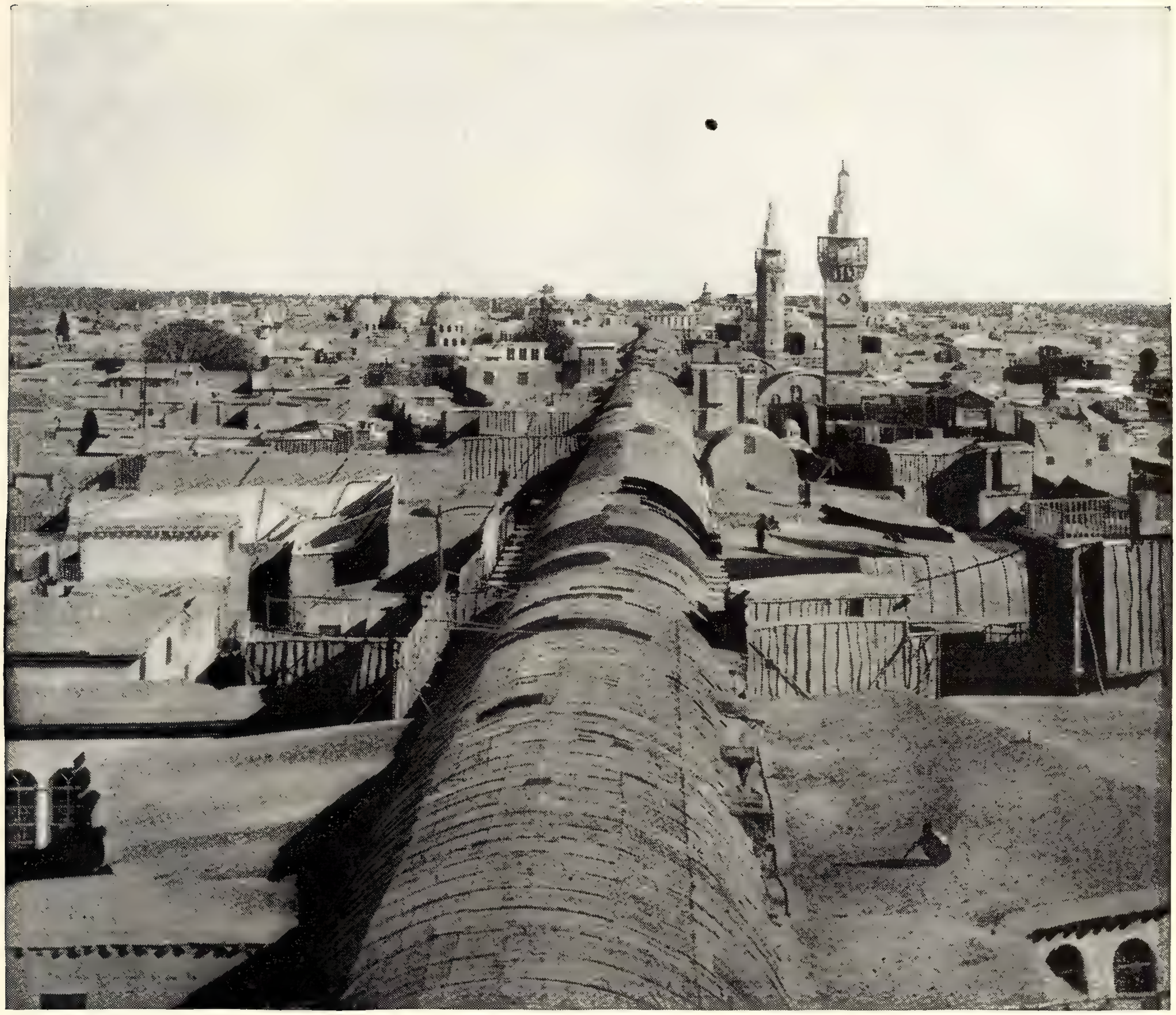
Cucumbers by the donkey loads are for sale on the streets of Damascus. For a good part of the year 6 pounds weight may be bought for 2 or 3 cents

of each other, may be seen the vender of cucumbers with his wares fresh from the garden, exposed on a donkey's back (when sold the load will realize between 20 and 30 cents); the bread-seller with his warm cakes of bread on a tray resting on a stand ready to supply the hungry with a good-sized loaf for a cent, and the vender of milk, who for another cent will give you a large basin of sweetened milk in which to soak your loaf. At different seasons you may fare well at little cost off melons, grapes, apricots, plums, peaches, apples, oranges, figs, etc., all the products of the gardens and orchards around the city.

But some will ask whence comes all this abundance, for in no other part of Syria or Palestine is there such a profusion of fruit and vegetables at such low prices. The cause is the abundant water supply provided by the ever-flowing and life-producing river Barada, the Abana of the Bible.

Rising some miles northwest of the city, the river is conducted to all parts of Damascus through thousands of channels. It is also tapped to irrigate the gardens, orchards, and fields outside the city that are constantly under cultivation to supply the needs of the inhabitants.

There are many pleasant spots by the



ROOF OF "STRAIGHT" STREET IN DAMASCUS

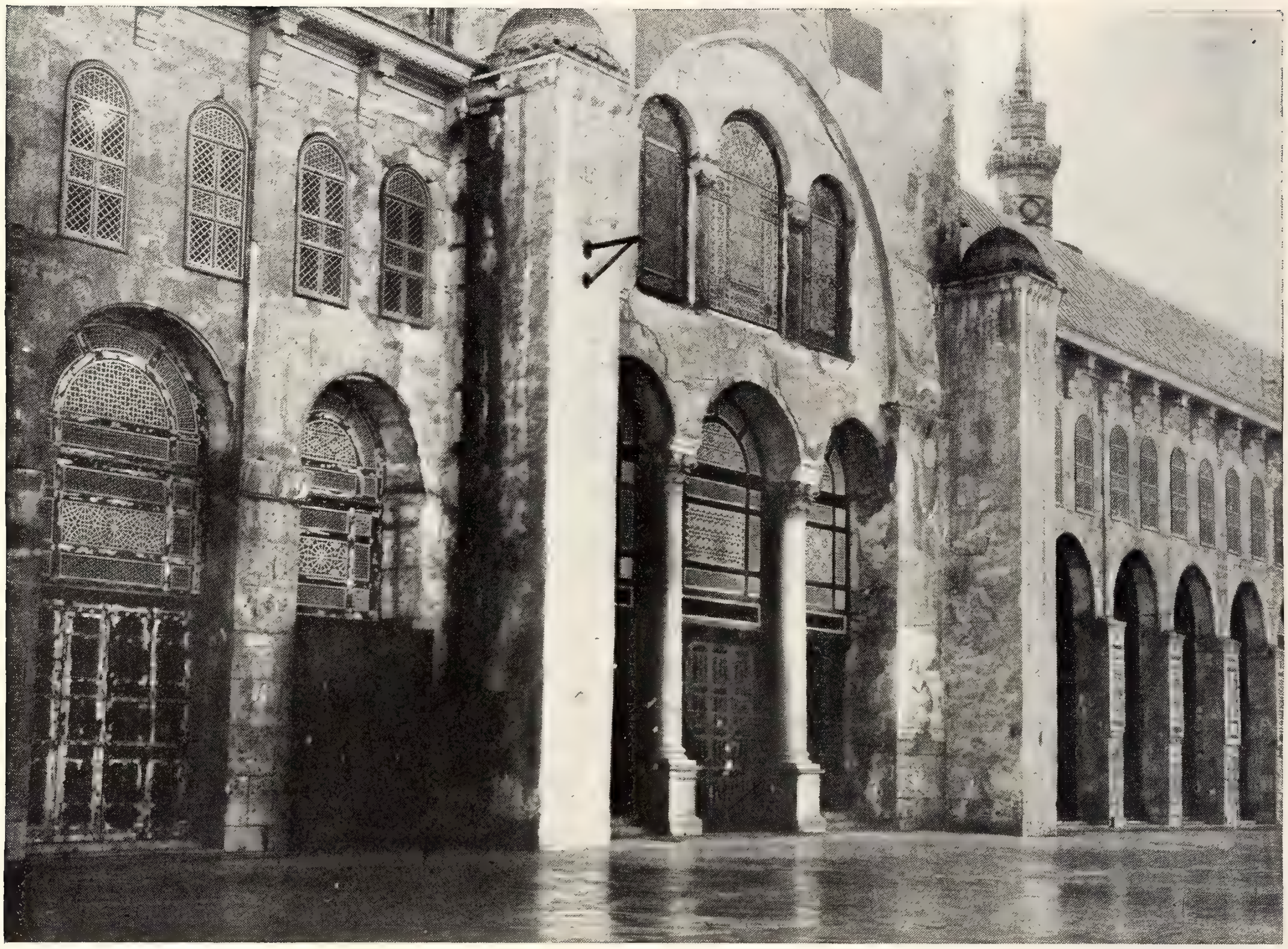
This view, taken from a minaret, makes it appear as though a huge pipe ran across the city between the houses, whereas it is only the arched roof of the longest street in Damascus

river's side, whither the Damascenes resort after the work and business of the day to pass an hour over the coffee cup or the ever-acceptable water-pipe as they talk over the news of the day or the doings of the outer world as revealed to them through the Arabic or Turkish papers.

Would you investigate closer some of the most primitive and interesting doings of the Damascene, turn aside to the place where the famous Damascus curtains are made, and there in semi-darkness you will find dozens of lads and men engaged in weaving these requisites of the home on the most primitive of looms, and yet they are able to produce an article that will compete with anything from the most complete and up-to-date factory in Europe.

Or, would you see how thousands of bushels of flour and measures of oil are produced, you have only to turn aside into one of the many mills to see that instead of steam the patient camel is used to turn the mill whose stones crush the grain or bruise the berries or seeds from which different oils are extracted. Some will say, primitive, indeed; but the Damascene's reply would be that it is effective and inexpensive; and, where time is of little object, these are important items.

But the sights of Damascus are not all on the streets. For a good view of the



EXTERIOR OF THE GREAT MOSQUE: DAMASCUS

The north wall and entrance shown here are part of the former building, but the windows, which are tiny pieces of colored glass, have recently been added. Most worshipers enter by this door.

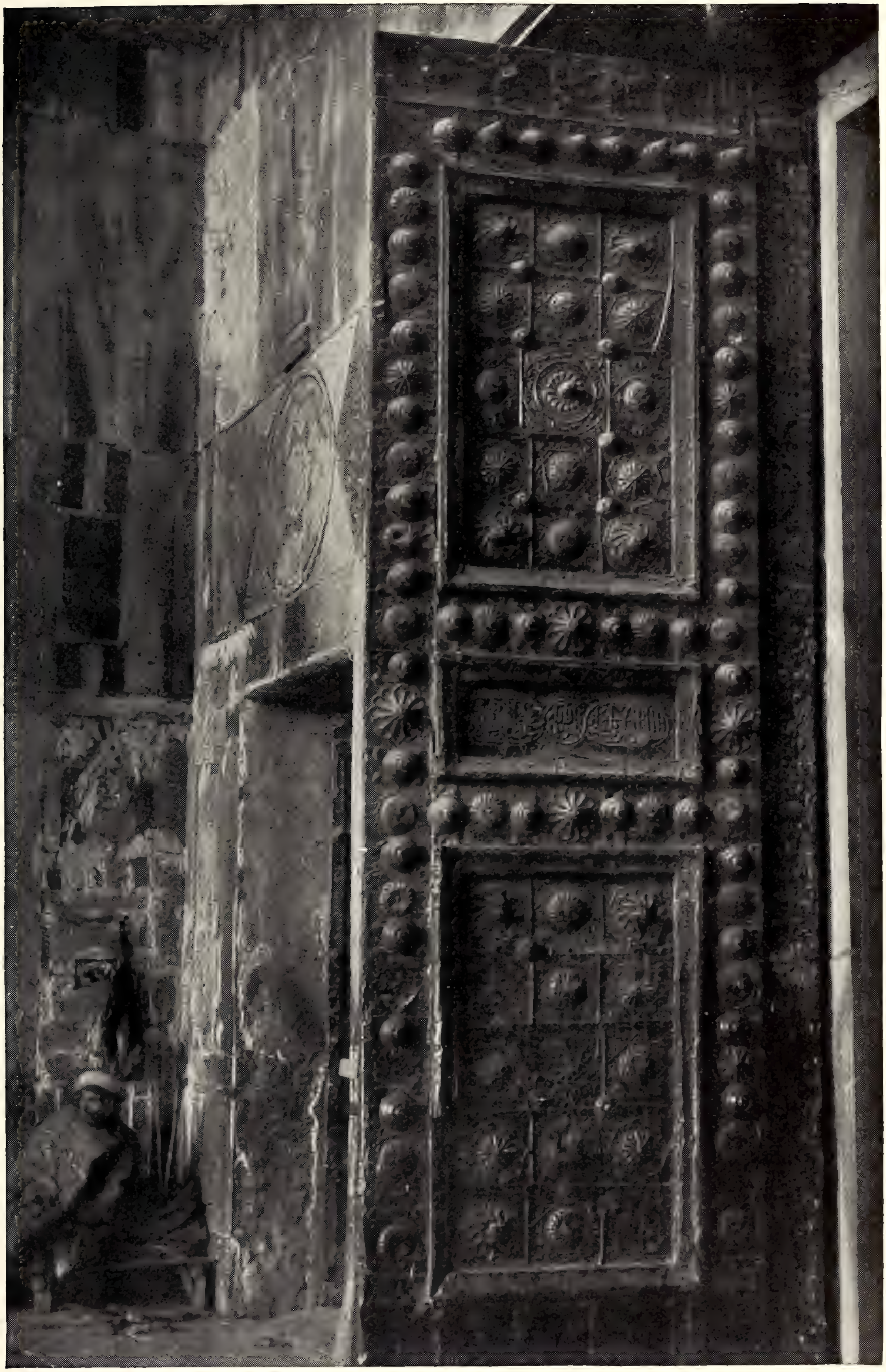
city itself you must get the favor of a minaret keeper, and have his permission to climb to the gallery of the minaret and from there look out over the roofs, courts, towers, and streets of the city beneath you. Be it said to the credit of the Damascene that, although he is a faithful follower of the "desert prophet." the fanaticism so often exhibited by Mohammedans is absent in him.

An interesting outlook of the city is obtained from a minaret near the west end of the street called "Straight." From this position one immediately appreciates how well that ancient thoroughfare deserves its name; for, as seen in the illustration, the street, which is roofed in, runs in a direct line across the city from west to east for about one and a half miles. This street still bears the same name as in the days of the Apostle Paul.

But the principal attraction of the city is the great mosque, which is located in the heart of the busy capital, and can only be reached through one of its many populous streets. This spacious resort for worship has recently been rebuilt, the funds being contributed from all parts of the Moslem world, for in 1893 the edifice had been almost entirely destroyed by fire.

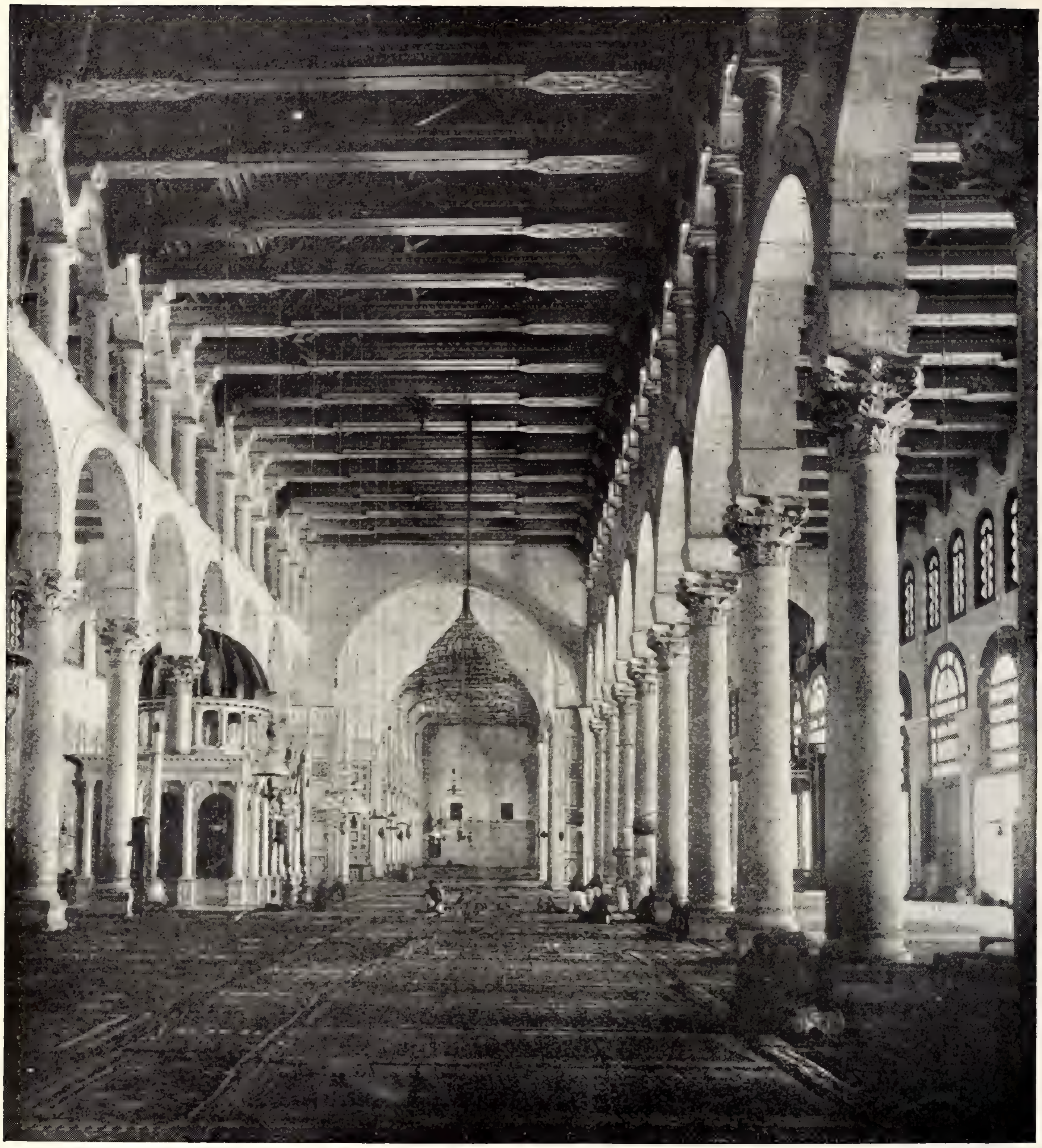
The mosque has had a varied experience, being at one time a heathen temple, then a Christian church, then held jointly by the Mohammedans and Christians and used as church and mosque at the same time, but since the eighth century the Mohammedans have had the sole use of it for their own purposes.

The outer court of the mosque is entered by three gateways, each guarded by massive bronze doors of great antiquity, and which were saved at the time



ANCIENT BRONZE DOOR TO THE GREAT MOSQUE

Without doubt it is hundreds of years old and was made when the Damascenes knew the art of working in bronze, an industry now lost in the Orient. The door is about 20 feet high

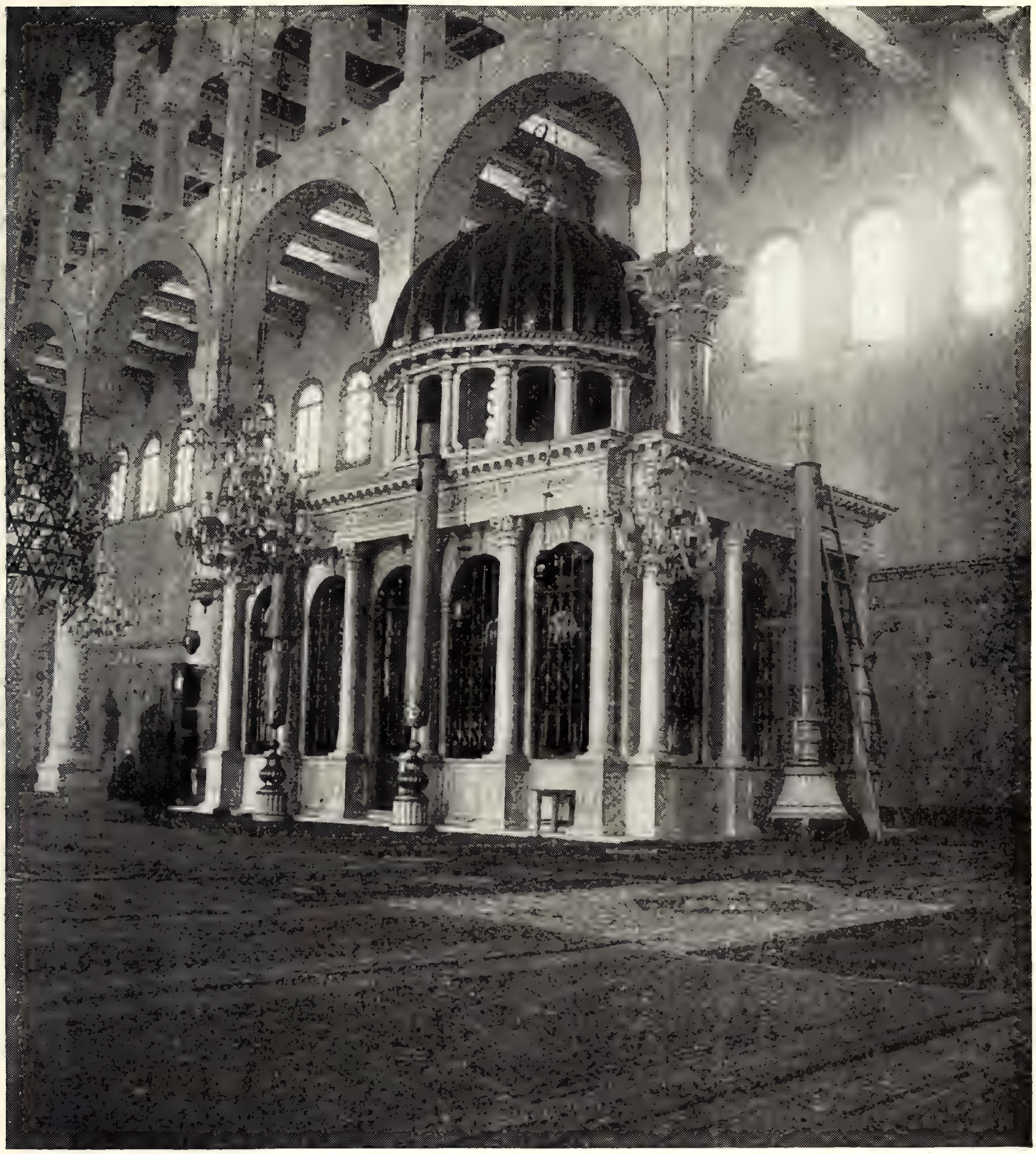


INTERIOR OF THE GREAT MOSQUE: DAMASCUS

The great place of worship for the Damascenes. Mohammedans from all parts of the Moslem world meet there. On Friday, when crowded with worshipers, the place is all too small. At any hour from sunrise until after sunset people may be seen going through their forms of prayer and worship. None are allowed in with their boots or shoes on. Note the rugs.

of the great fire. The workmanship of these doors is very fine, the detail showing that at some time there were those who were able to turn out work in bronze that will compete with anything of modern times. Because of the crowds that throng these entrances and the dark location they are in, it is difficult to secure anything like a good photograph of the gates, but the illustration will convey a fair idea of them.

We will enter by one of the doors on the north, and thus avoid giving offense by turning our backs on Mecca. The

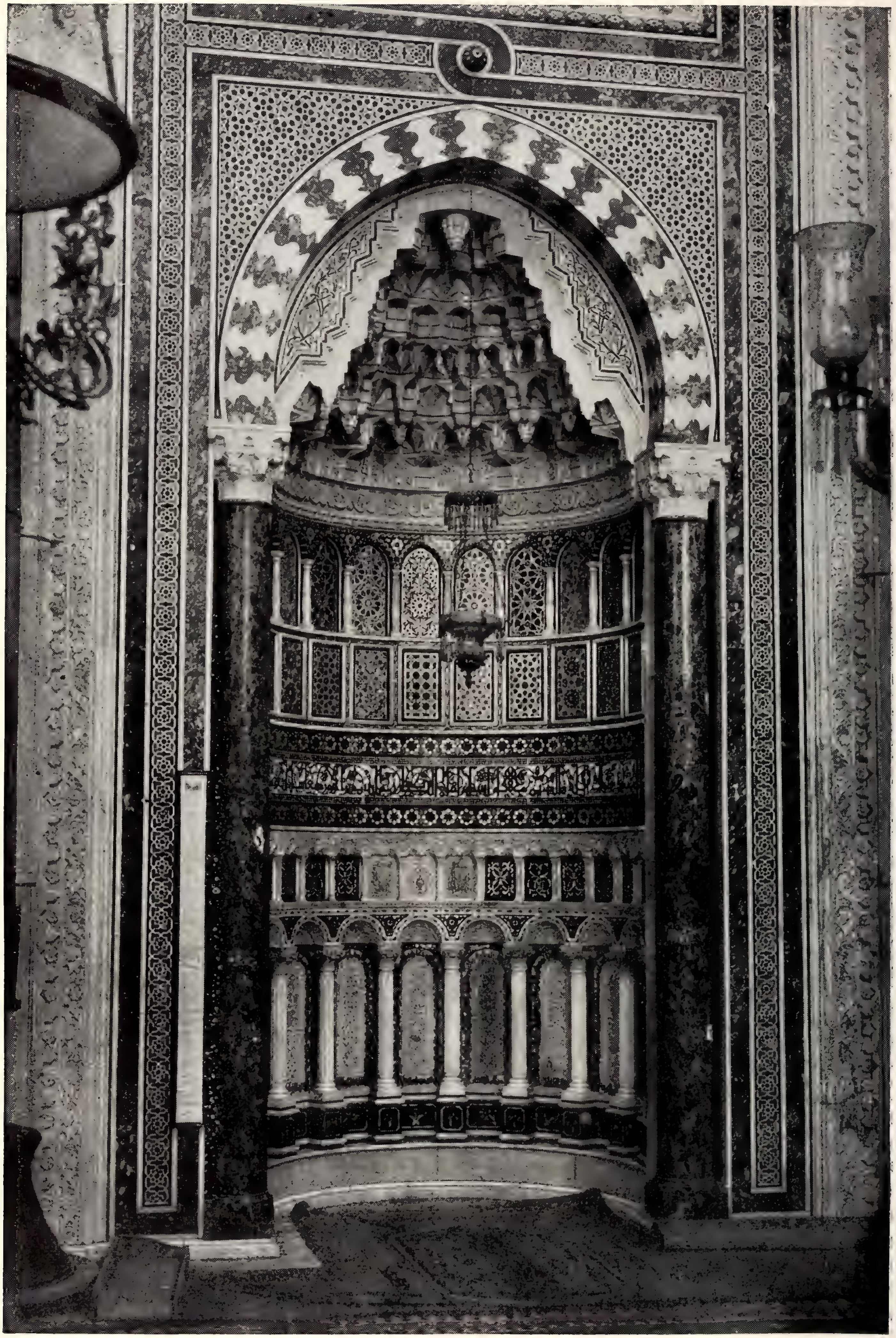


SHRINE TO JOHN THE BAPTIST IN THE GREAT MOSQUE AT DAMASCUS

The most costly shrine in Damascus, supposed to cover the place where the head of John the Baptist was interred, after being unearthed by one of the Saracen heroes of Damascus. It is revered alike by Christians and Mohammedans, but the latter claim the privilege of keeping it in good repair. Note the rugs.

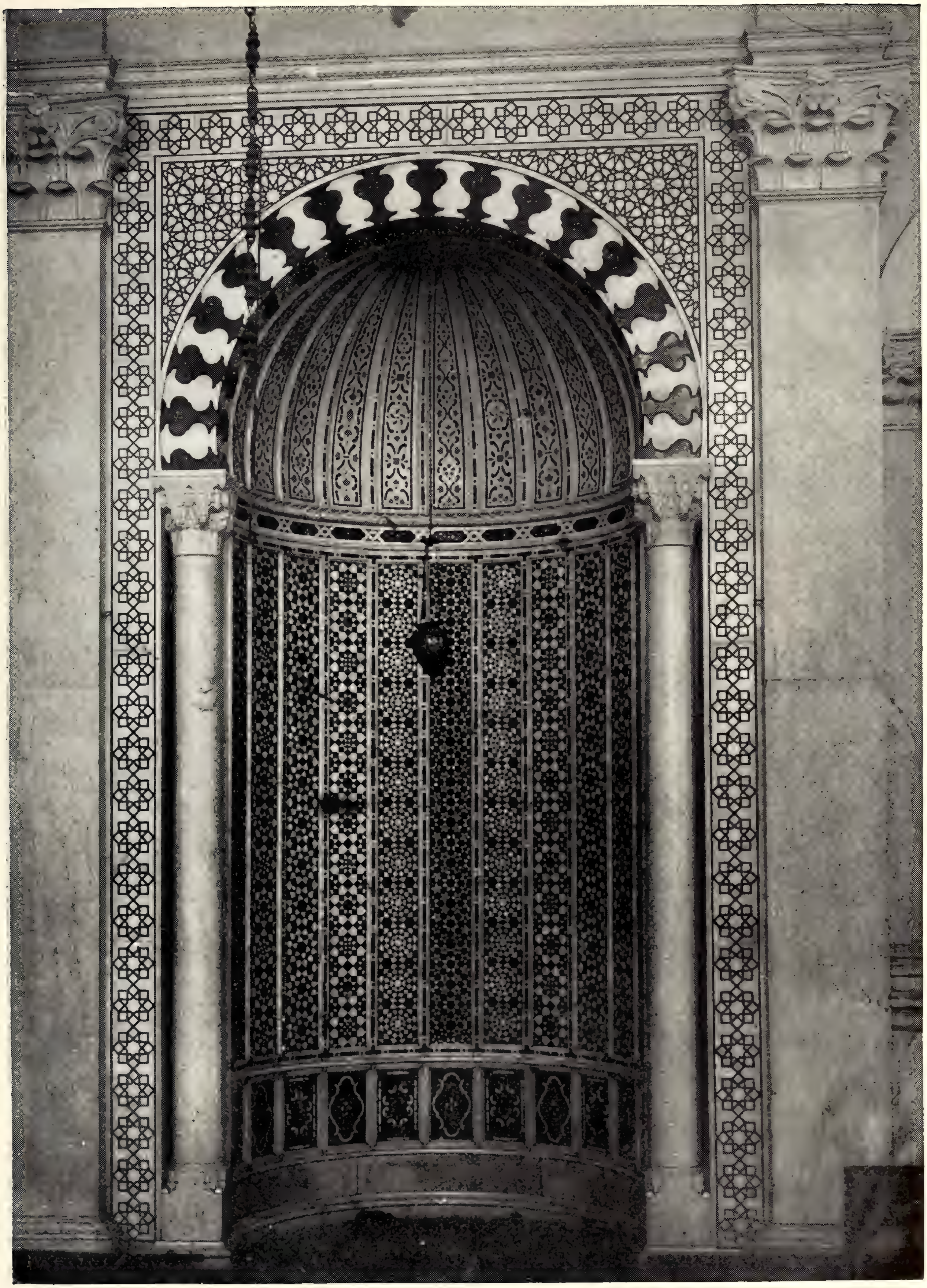
interior, which is quite 300 feet long, has a very imposing appearance, the numerous huge columns on either side adding materially to its grandeur. These columns, each 20 feet high, were all quarried in and brought from the adjacent mountains of Lebanon, and, for finish and workmanship, speak well for the ability of the Damascus stone mason. The floor of the mosque is usually covered with costly and beautiful rugs, the gifts of rich Mohammedans from all parts of the Orient.

On entering this magnificent place of worship the eye is at once attracted by an imposing and elaborately decorated structure that has a place between two of the massive columns near the center of the building. On inquiry you will be told that it is the tomb of John the Baptist's head, a shrine respected alike by Mohammedans and Christians.



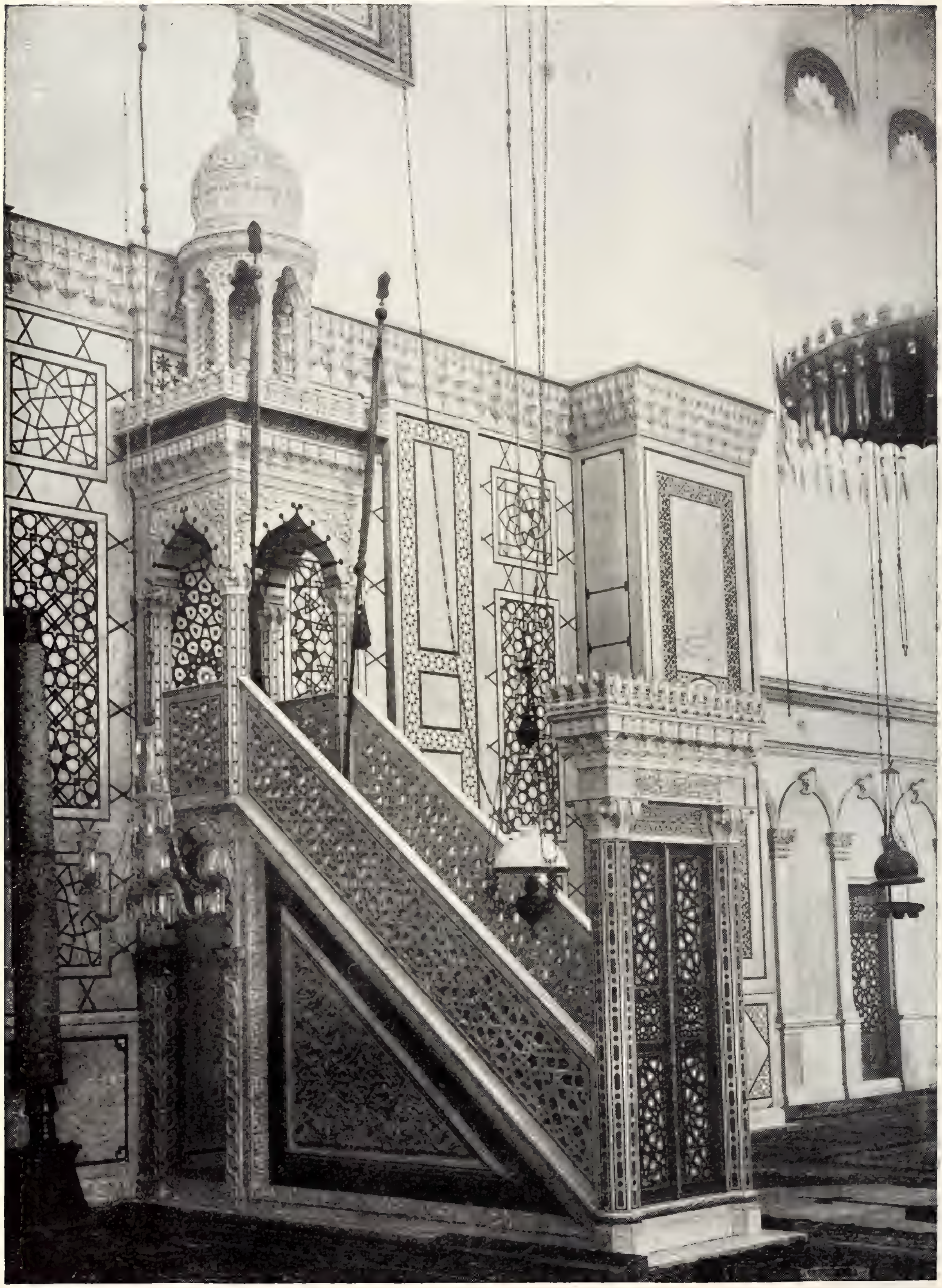
DAMASCUS' MASTERPIECE IN MODERN MOSAIC

This elegant and delicate piece of work took many months to complete and is the admiration, pride, and boast of Damascenes. Across the center, worked in tiny stones, are some verses from the Koran, so neatly joined as to give the appearance of handwriting. The side columns are red granite brought from Upper Egypt.



MODERN MOSAIC PRAYER NICHE

This exquisite production of a Damascus workman bears silent testimony to the sort of work the Syrian is able to do. The many pieces of colored stone and glass were gathered from different parts of Europe and Asia. The entire expense was borne by a rich citizen of the city.



ONE OF THE MOST COSTLY PULPITS IN THE WORLD

It is built entirely of marble, exquisitely carved and joined. Once a week the head of the religion ascends the stairs and from beneath the cupola preaches the weekly sermon to the thousands assembled before him. The pulpit was a thank-offering from one of the rich citizens of Damascus. Note the modern kerosene hanging lamp.

The local tradition says that after the execution of the Messiah's forerunner his head was sent to Damascus, then the capital of the district over which Herod had jurisdiction, so that his superior officer might see that the deed had really been done and one supposed inciter to rebellion disposed of. When the Saracen conqueror Khalid captured Damascus and was searching the church for treasure, he came across this revered relic and caused it to be interred and covered by a fine structure, which has been carefully preserved ever since. The dome of this monument is covered with green, the religious color of the Mohammedans, surmounted with the star and crescent. The sides, which are cagelike in appearance, are of brass rods and filagree-work of very exquisite design. The fact of this shrine being in the mosque accounts for the laxity regarding the entrance of Christians as compared with mosques in other Mohammedan cities.

In the south wall of the building are two exquisite pieces of modern mosaic-work of which the Damascenes are justly proud.

These form prayer niches toward which the faithful turn when engaging in their devotions, as they face toward Mecca, their holy city. The niches, which are about 10 feet high, are made up of hundreds of tiny pieces of colored marble, glass, granite, and other stones gathered from all parts of Europe and Asia, and are the work of men resident in the city. Every one of the tiny columns seen in the work is delicately carved and must have required infinite patience and ingenuity.

Both niches are the gifts of rich Moslems as thank-offerings to God for a safe return from the long and trying pilgrimage to Mecca, some 800 miles distant across the Arabian desert.

West of these modern mosaics is another fine piece of work in the shape of a massive pulpit worked and carved entirely in white marble, brought from the quarries of Italy but worked in Damascus.

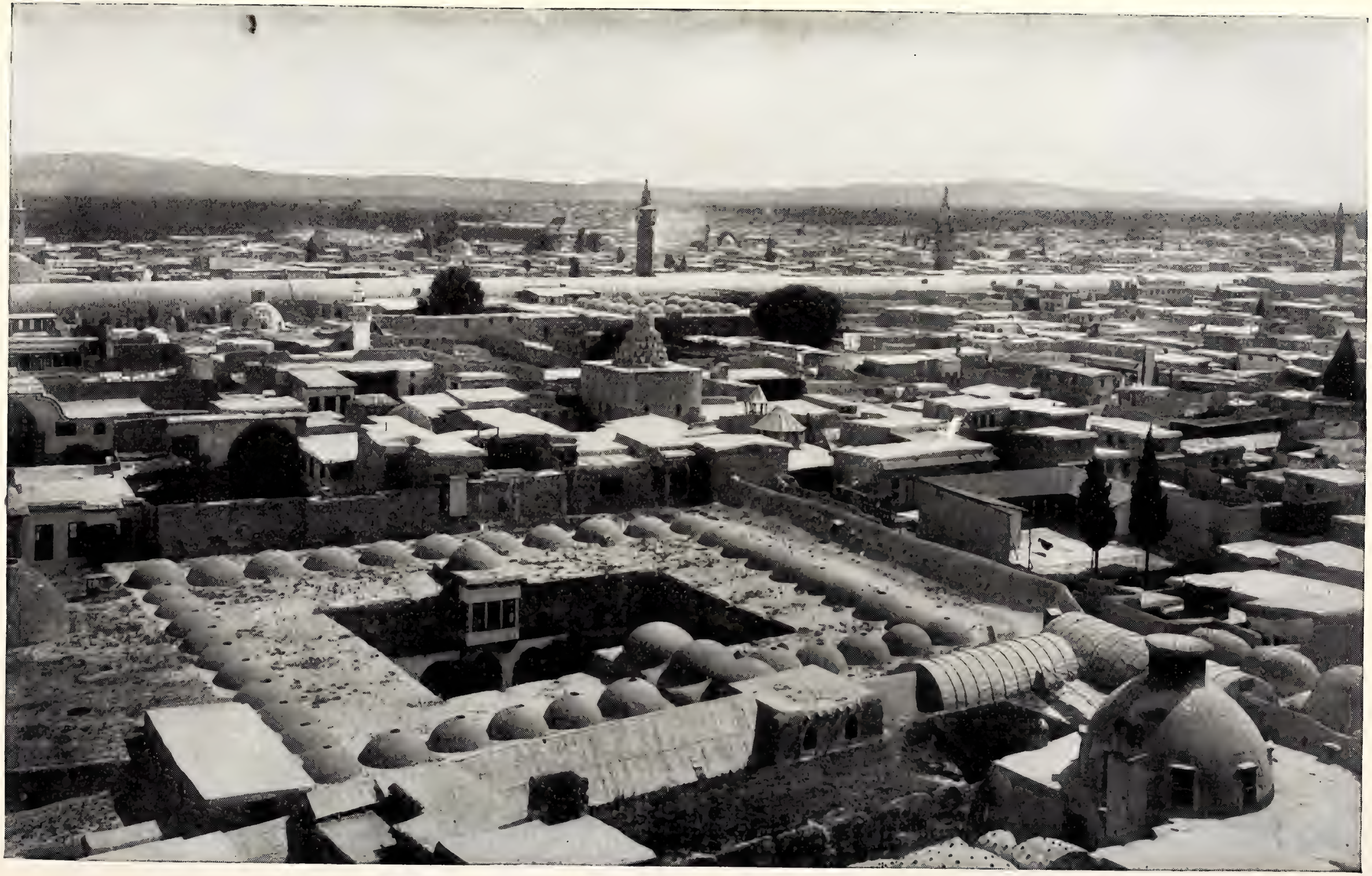
From this pulpit the weekly sermon is preached to the crowds who have gathered for the Friday service, that day being equivalent to the Western Sunday. This delicately wrought piece of filagree-work in marble is also a gift to the mosque in return for blessings received.

A visit to the mosque is usually concluded by ascending the minaret on the southwest side of the building, the only one that survived the fire already referred to. The minaret is of pure Arabian workmanship and is a wonder of skill and design. In shape it is octagonal, and has three galleries, one above the other, tapering toward the top and ending with a ball surmounted with the crescent. Unlike the other two minarets, this one is built of different-colored stones, which from a distance give it a very pleasing appearance.

From the gallery a magnificent view of the city is to be had. The main bazaars and streets are prominent because of the semicircular roofs over them; the many tiny domes with glass windows locate the numerous Turkish baths of the city, which are well patronized by the inhabitants; the well-preserved Crusading castle in the center of Damascus denotes the military headquarters of the troops, while the spots of green interspersed about the city tell of many a shady courtyard, fragrant with flowers and trees, continually watered from the fountain that plays in its midst.

Beyond the city may be seen barrenness, fertility, mountain, and plain, while the many-miled circle of green that encompasses the town is a sight never to be forgotten. It is not to be wandered at that the Damascenes are proud of their city and think there is no other like it, and well they may, for its equal has yet to be found.

Damascus is a city of sacred shrines, for many worthy and brave men have been interred there. From a military point of view the tomb of Saladin, the great hero of the Saracens, is the most important in the city. It is to be found in a small mausoleum attached to the great mosque. A glass case at the head of the marble sarcophagus contains a



GENERAL VIEW OF DAMASCUS

Some idea of the length of the bazaars may be gathered from the long line running across the illustration which shows the roof of part of one of the main streets. The quadrangle in the foreground is one of the many two-storied caravansaries in which the caravans find shelter and merchandise is stored.

TYPICAL SACRED SHRINE

Scores such as this may be seen in and around the city of Damascus. They are much revered by the natives

golden wreath placed there by the present Kaiser during his visit to the city. Great and deep offense was given to the Damascenes because worked into the wreath was a cross. The Mohammedans petitioned Constantinople for its removal, but the late Sultan ordered it to remain, as it was put in place by the German Emperor.

To the religiously inclined the tomb of Fatima, the only child and daughter of Mohammed, is the most important in the city, and is to be found among the thousands of graves at the north end of the long Meidan. It is inclosed by an iron cage, and is the constant care of scores of women.

Beibars and his son, both great heroes of the Saracen period, have their tombs in Damascus, and are visited by thousands of men yearly. In many of the mausoleums of these worthies are stored heaps of valuable manuscripts which, if searched and translated, might add valuable information to the history of the Orient.

Damascus as a center for trade is probably unequaled in the Turkish Empire. From its forges all kinds of ironwork are carried into Central Arabia; from its many looms clothing and curtains of silk and cotton are transported to all parts of Asia and Europe; from its bazaars saddles, brass-work, and confectionery are taken to Constantinople, Bagdad, and the large cities of the East. Its apricots are parboiled and then exported by the thousands of cans to France, and from its silk-winding machines thousands of skeins find their way to all parts of the civilized world.

To its many merchants and skilled workmen come by steam and camel-train the raw products of the world—mother-of-pearl from the Persian Gulf; ebony, mahogany, and precious woods from India; spices from Yemen and Persia; rugs and carpets from Armenia and Mesopotamia; leather from Europe; iron, brass, and steel from England; paper, cloth, cotton goods, and sundries from Germany, and petroleum for lighting purposes from Russia, with a limited supply from America.

The fertile Hauran and the extensive plains of Moab furnish the wheat and barley necessary for such a large city. The grain is brought thither on camels' backs or by the Mecca railway. This Mecca railroad has caused Jerusalem to suffer considerably, because the large supplies of wheat and native produce which the Holy City originally obtained east of the Jordan are now all sent by rail to Damascus.

There is no doubt that Damascus, as the terminus of the Aleppo, Haifa, Beirut, and Mecca railroads, is bound ere long to become the hub of the East. To and from it will radiate trade and commerce such as it has not known in all its history.

SURVEYS IN THE PHILIPPINES

ALTHOUGH Spain created a hydrographic commission for the Philippines as early as 1834, no systematic surveys were conducted by it, the Spanish vessels being too much occupied in the suppression of piracy and in performing other police duty. They found time, however, to make several chronometric expeditions for determining longitudes and to make geographic explorations along the coasts. The resulting charts are to be regarded as mere reconnaissances, with the exception of a few detailed surveys in detached localities. These were supplemented by a British survey of the west coast of Palawan, between 1850-'54, and other exploratory surveys by the British.

It was not until the end of 1900 that the United States Coast and Geodetic Survey began to extend its activities to the Philippine Archipelago, and to conduct a systematic hydrographic and topographic survey of the shores, based on accurate and continuous triangulation, by means of which all the surveys have been properly coördinated. The extension of the telegraph and cable lines offered the desired opportunity for the precise longitude determinations which were made, and which, in connection with latitude and azimuth observations, completed the required data for fixing the triangulation on the map of the world.

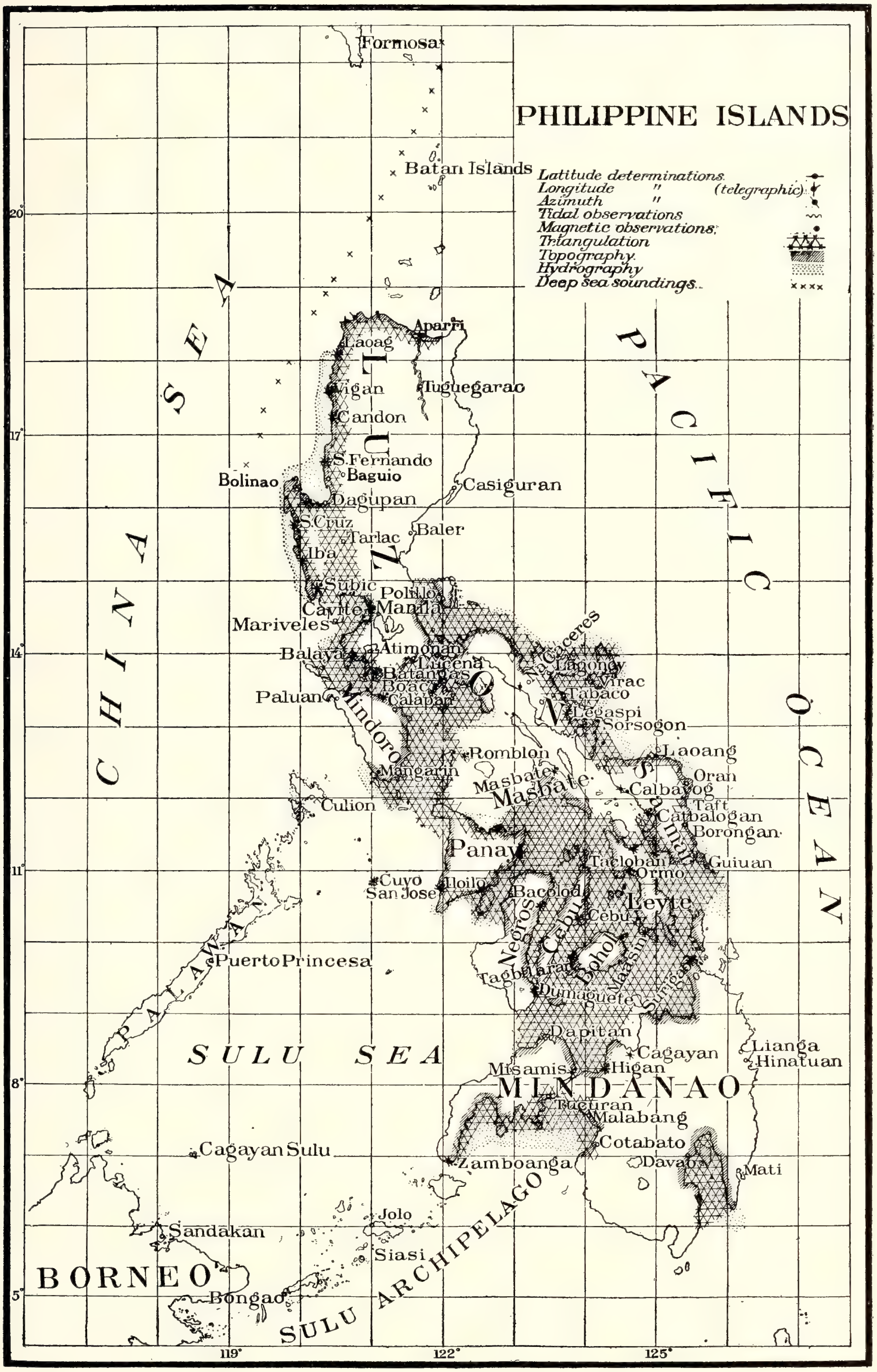
In addition to its immediate purpose, this triangulation forms the basis for the extension of cadastral and topographic surveys into the interior, a work which has been taken in hand by the Philippine government. The latter has contributed about $70,000 a year to the work of the Coast and Geodetic Survey, in addition to the sums appropriated by Congress.

The most pressing needs of the mariner have been met by the publication of about 120 charts by the Coast and Geodetic Survey, the great majority of which are based on its own work. The gratifying progress made is shown on the accompanying sketch-map, which represents the condition of the work at the end of June, 1910, and which indicates that a great contribution has been made to accurate cartography.

P. A. Welker,
U. S. Coast and Geodetic Survey.

ACKNOWLEDGMENT

THROUGH inadvertence the authorship of the short article, "The Man Without the Hoe," published in the last number of the magazine, was not credited to Mr. J. Grinnell, of the University of California, Berkeley, California. The two illustrations accompanying the paper were from photographs by Mr. Grinnell, and should have been credited to him instead of to "J. Griffin."

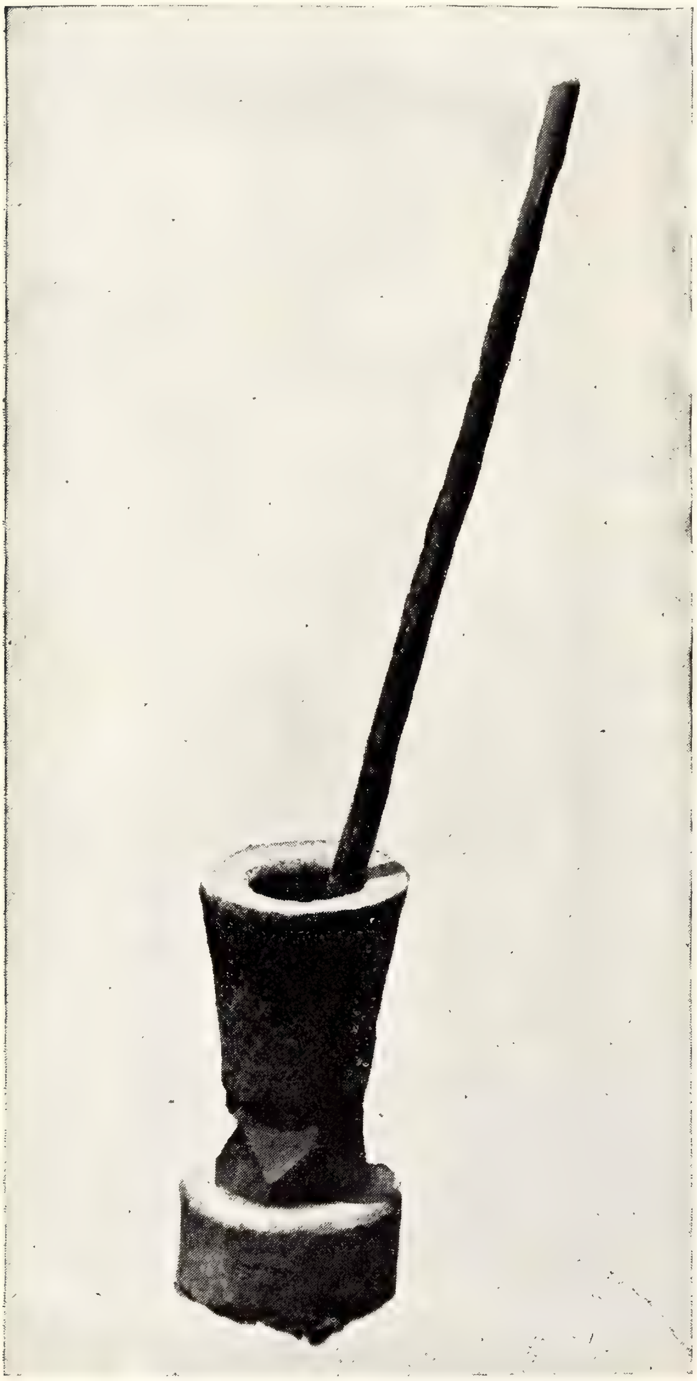


OUTLINE MAP OF THE PHILIPPINE ISLANDS, SHOWING THE PROGRESS OF THE TOPOGRAPHIC AND HYDROGRAPHIC SURVEY OF THE ISLANDS BY THE U. S. COAST AND GEODETIC SURVEY

DUMBOY, THE NATIONAL DISH OF LIBERIA

By G. N. Collins

To attempt the description of a gastronomic novelty is like attempting to describe a landscape. The constituent parts can be described and the manner in which they are combined, but it requires something more than accurate description to reproduce the sensation of the original. To those who have actually witnessed a particular view, even a feeble description may suffice to recall the original impression. It is the same with tastes and odors; but there are few who have known the pleasures of Liberian dumboy.



MORTAR AND PESTLE FOR BEATING DUMBOY

To these the mere name will recall a picture of some little native town at sunset, surrounded by the somber tropical forest, where the stillness is broken only by the appetizing crack of the pestle. The thought of a chicken dumboy with "whaney" and "kiffy" seed will obliterate all impressions of the steaming heat and the mad fevers, and leave only a desire to taste again this most fascinating dish. To the uninitiated I fear that any description I can give will only leave the impression of a barbarous concoction, and may perhaps arouse disgust.

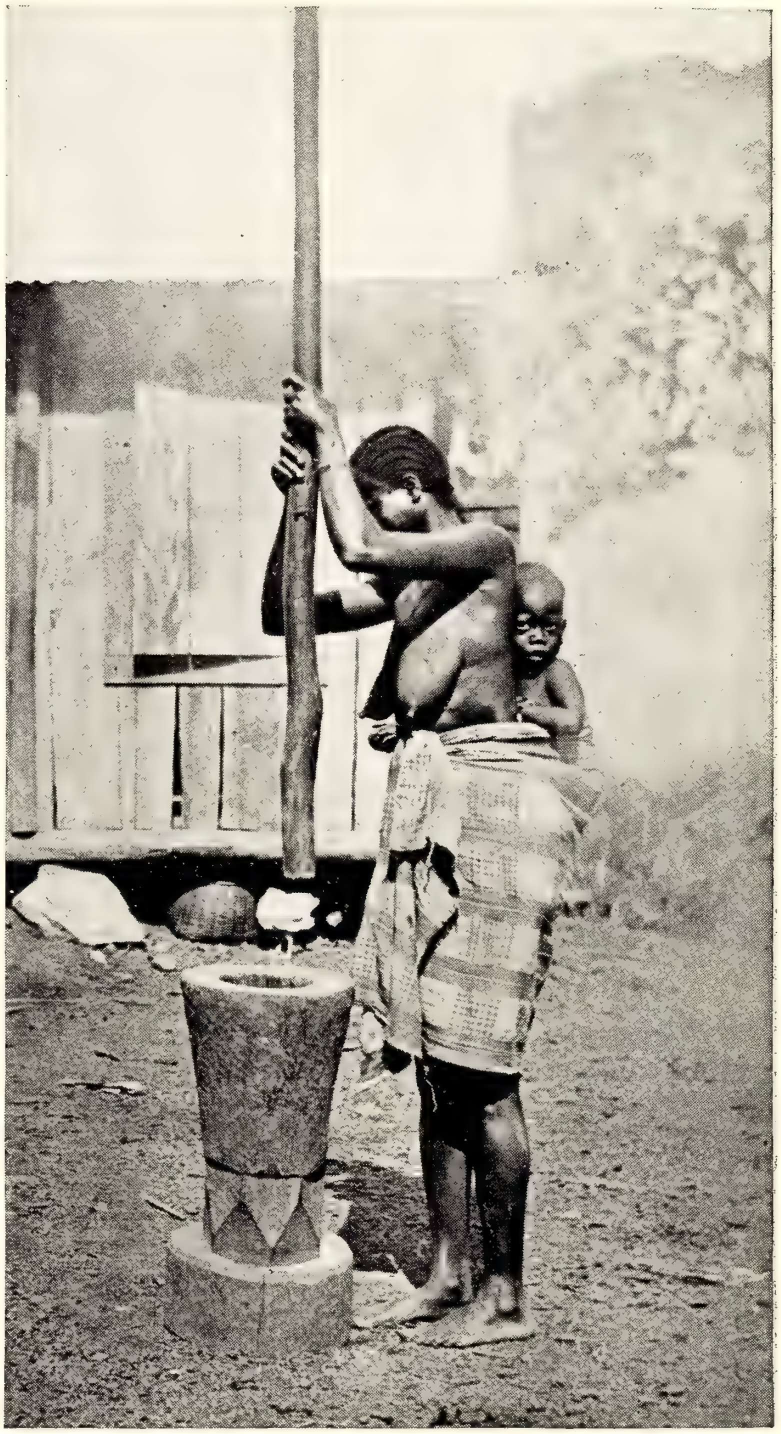
The principal ingredient of dumboy is cassava, or "cassada," as it is called in Liberia. The edible roots of this plant, known botanically as *Manihot utilissimum,* are the source of tapioca and some of the forms of sago. There are a great many varieties of cassava, classified usually as either "bitter" or "sweet." The roots of the "bitter" sorts contain considerable quantities of prussic acid, and are poisonous unless cooked. There seem to be no visible characters distinguishing the sweet from the bitter, and recent investigations indicate that the poisonous ingredient of the bitter varieties is developed only under certain conditions of soil and climate. All the varieties in Liberia are sweet, and may be eaten raw with impunity.

To prepare the roots of cassava for dumboy they are peeled, boiled, and all fibers from the center are removed. The cooked roots are then placed in a large wooden mortar and beaten with a heavy pestle (see figure on page 85). This beating requires considerable skill and experience. In the hands of a novice the pestle sticks to the dumboy, and the result is a lumpy and inedible mass. To prevent the sticking, the pestle is dipped in water; but unless the water is used very sparingly the dumboy becomes sodden.

The beating requires about three quarters of an hour, and is hard work. As the beaten mass becomes homogeneous the pestle produces a loud crack each time it is drawn from the mortar. These sharp reports can be heard for long distances through the forest, and are a very welcome sound at the end of a day's journey.

When the dumboy reaches this stage the operator may rest without injury to the quality of the product; but, once the beating is carried past this point, it must be rapidly completed and the dumboy eaten at once. If the natives are to be believed, it is actually dangerous to eat dumboy that has stood for more than a few minutes after it is beaten. If allowed to stand long it becomes very hard, broken pieces of dried dumboy being a favorite kind of shot for use in the long muzzle-loading guns of the natives. A casing of dumboy is also used to stiffen the leather sheaths of the native swords and knives.

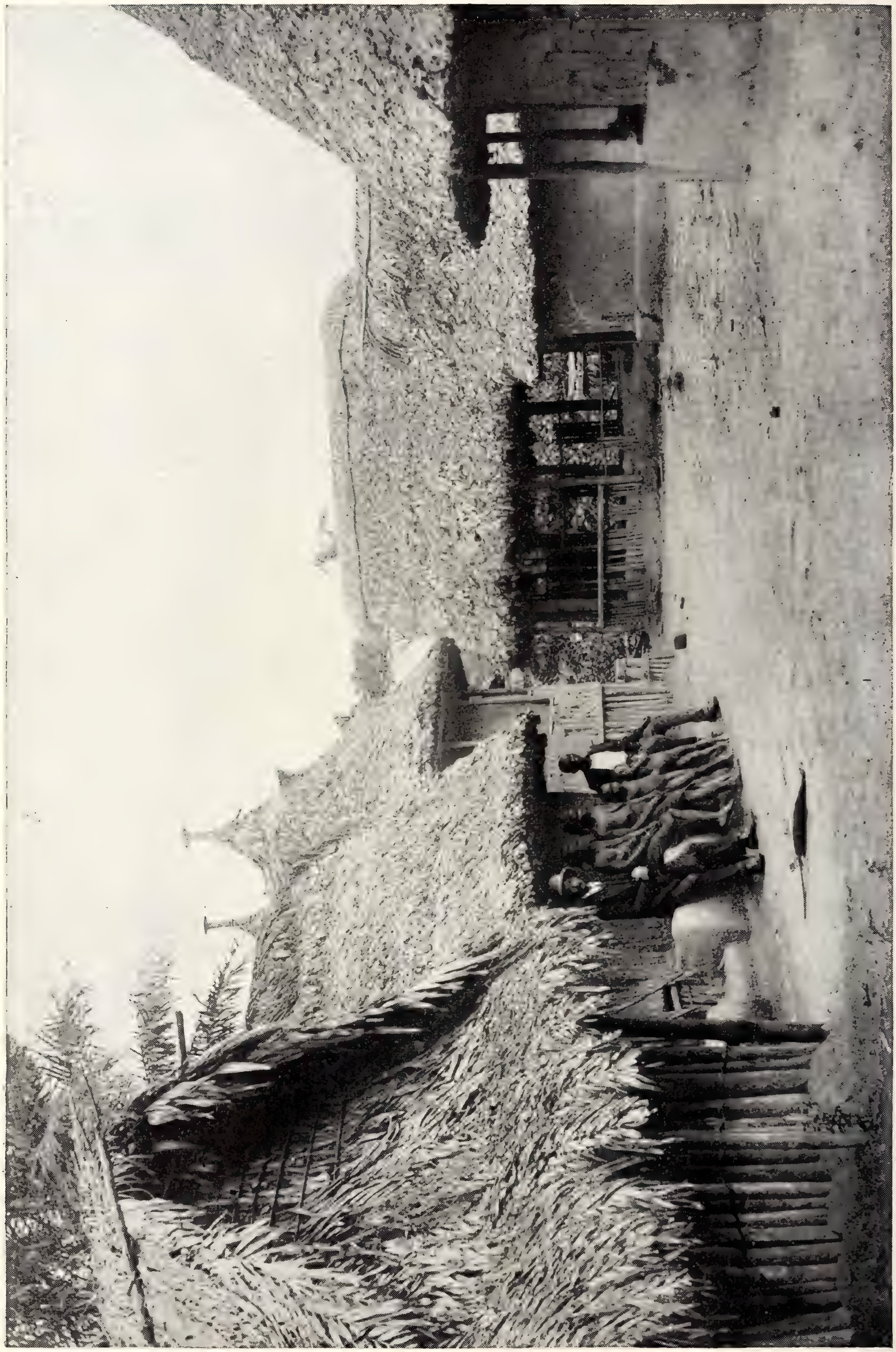
As soon as the beating is finished the dumboy is taken from the mortar and placed in shallow wooden bowls (see figure on page 88). The native method is to place the entire quantity in one large bowl from which all the partakers eat. If divided, the customary portion for each person is a piece about the size and shape of an ordinary loaf of bread.



POUNDING THE CASSAVA TO MAKE THE DUMBOY

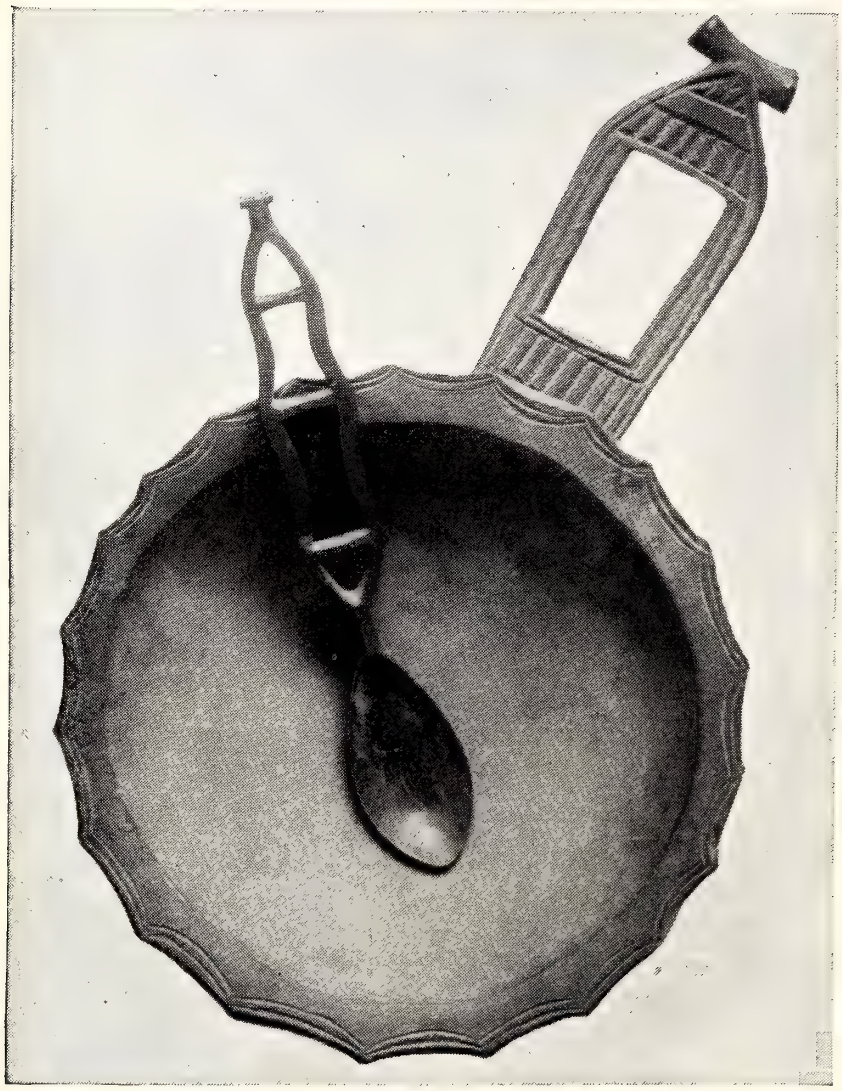
A soup which has been prepared while the dumboy was being beaten is now poured into each bowl. There is great variety in this soup, which imparts most of the taste to the dish. There is always a stock of some form of meat. This may be either chicken, deer, fish, monkey, or even canned beef. To this are added as many vegetables as can be obtained, the choice depending upon the season.

The list includes sweet potatoes, breadfruit, eddoes (the Liberian name for yautia), and, if possible, "whaney." Whaney is the juice squeezed from the pulp that surrounds the seed of the oil palm. It is not attractive in appearance, but imparts a rich flavor to the soup. In any case, parched "kiffy," or "beni," seed must be added as a condiment. Kiffy is a small melon-like plant, the seed of which are parched and finely ground. Beni (*Sesamum orientale*) is the plant commonly known as sesame. The seeds are treated in the same way as kiffy seed, and have very much the same taste. The parched seeds of either of these plants is a delightful condiment.



GOLAH TOWN IN THE INTERIOR OF LIBERIA

GROUP OF GOLAH WOMEN IN THE INTERIOR OF LIBERIA, WHERE DUMBOY IS THE FAVORITE FOOD



WOODEN BOWL AND SPOON USED IN EATING DUMBOY

As soon as the soup is added the dumboy is ready to be eaten; and, while the ingredients are somewhat bizarre, the method of eating the dish strikes the traveler as even more startling. The mass of dumboy, which can best be described as a sticky dough, will adhere instantly to anything dry, but is readily cut with a wooden spoon if the spoon is kept moist with the soup. An incredibly large piece is cut off with the moistened spoon, taken up with a quantity of the soup, and swallowed whole. No one thinks of chewing it, and it is customary to caution the novice by tales of the frightful operation necessary to separate the jaws once the teeth are buried in the sticky mass.

As might be expected, few Europeans like dumboy on first acquaintance; and, with some, the initial distaste prevents further experiments. If a second or third attempt is made, however, and the dish has been properly prepared, the habit is usually formed, and before long every night spent in the bush without a meal of dumboy is counted a privation. Among the white residents of Liberia, fondness for this dish amounts almost to a cult. It is regarded as a sort of guaranty that one's tenderfoot days are over.

While cassava is a staple food throughout West Africa, dumboy seems to be peculiarly Liberian. The dish in no way resembles the "fou fou" of the neighboring colony of Sierra Leone, though made of the same material. It must be unknown in the parts of Africa familiar to Sir Harry Johnston, for the account given in his work on Liberia is erroneous. A dumboy prepared in the way described by him would be quite inedible.*

The great diversity in the methods of preparing cassava for food that obtains among the tribes of West Africa would seem to argue against the generally accepted belief that cassava was unknown in Africa until after the discovery of America by Columbus. There can be no doubt that the plant is of American origin; but, if introduced after the time of Columbus, it must have been taken up with marvelous rapidity, and the natives must have evinced an ingenuity in inventing new methods of preparing the food in striking contrast to their present conservatism.

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* Johnston, Harry, Liberia, II, p. 990.

NOTES ON OMAN

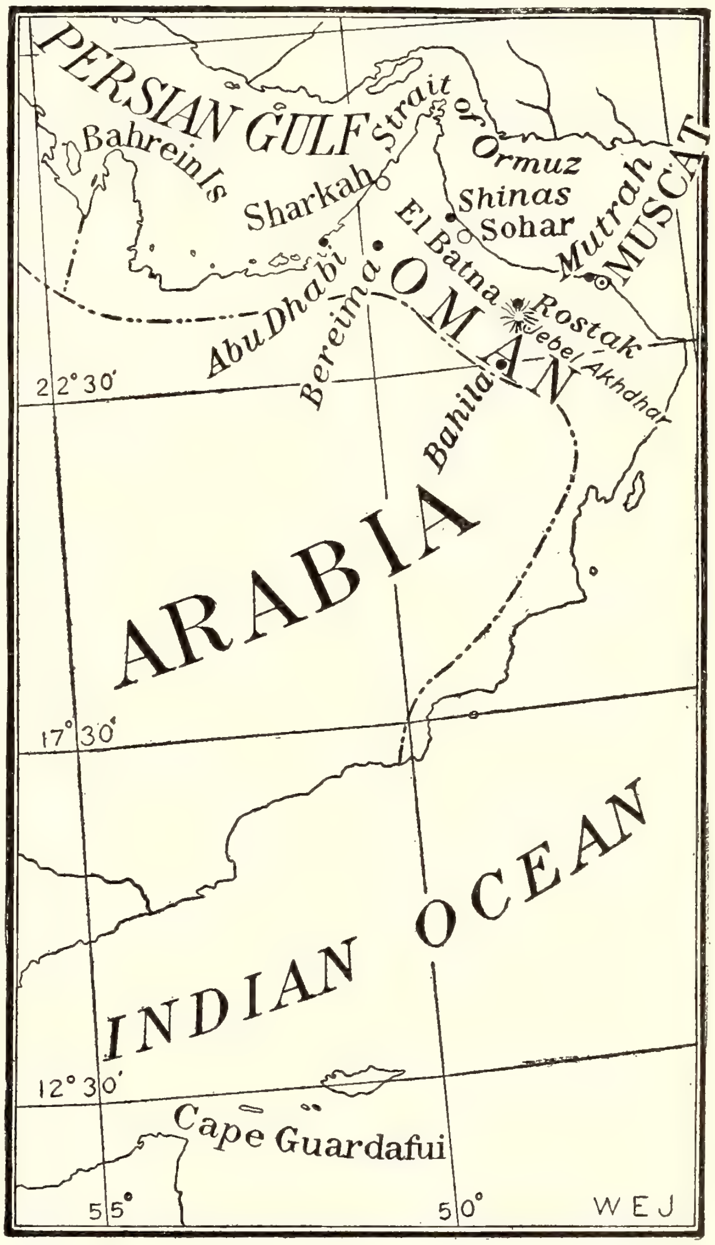
By Rev. S. M. Zwemer, Bahrein, on the Persian Gulf

AMONG the most unknown regions of the earth geographically is the Arabian Peninsula, and one of its least-known provinces is Oman. Historically, politically, and geographically Oman has always been isolated from the rest of Arabia. Ever since the days of the caliphate, and as far as outside communication with other Arabs is concerned, Oman was practically an island, with the sea on two sides and the desert on the other. The people are, therefore, even more primitive in their habits than the Arabs generally, and only recently have other towns than Muscat, the present capital, opened their eyes to the wide world.

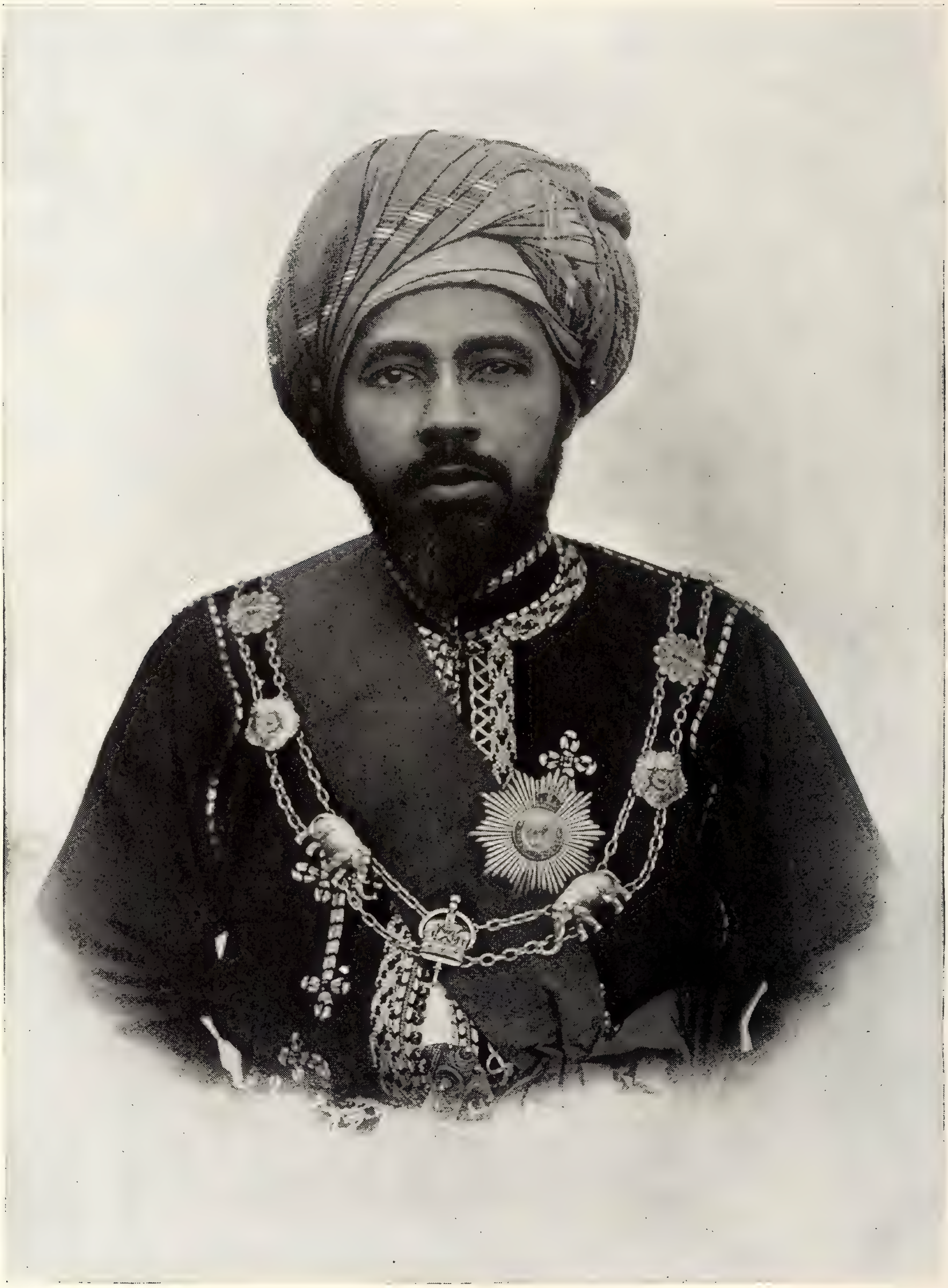
The coast line of Oman extends for about a thousand miles, from the Strait of Ormuz, southeast and southwest; the province has an area of 82,000 square miles and a population estimated at 800,000 by the Statesmen's Year Book, but by Colonel Miles, who has seen more of the interior than any other recent traveler, at over 1,000,000. The capital, Muscat, and the adjacent town of Mutrah have together about 25,000 inhabitants. The ancient capital, Rostak, has declined in importance since Muscat was occupied by the Portuguese, from 1508 to the middle of the seventeenth century.

Ahmed bin Sa'eed, originally from Yemen, captured Muscat and was elected Imam of Oman in 1741. His family have since been the rulers of this part of Arabia, and the present Sultan came to the throne on June 4, 1888. At the beginning of the last century the power of the Imams of Oman extended over a large part of Arabia, the islands in the Persian Gulf, a part of the Pirate Coast, and a long strip of the African coast south of Cape Guardafui, including Socotra and Zanzibar. At this time the slave trade was flourishing, and it was the Arabs of Oman who explored the great interior of Africa long before the days of Speke and Livingstone. On the death of Sultan Sa'eed in 1856 two rival sons divided the government, one becoming the Sultan of Zanzibar and the other of Muscat.

The present Sultan has for many years been under the protection of the government of India, and Oman is practically a native state like other states in India. A British consul and political agent resides at Muscat, and although the Sultan's revenue amounts to about $250,000 his authority does not extend far inland, and there is little security for

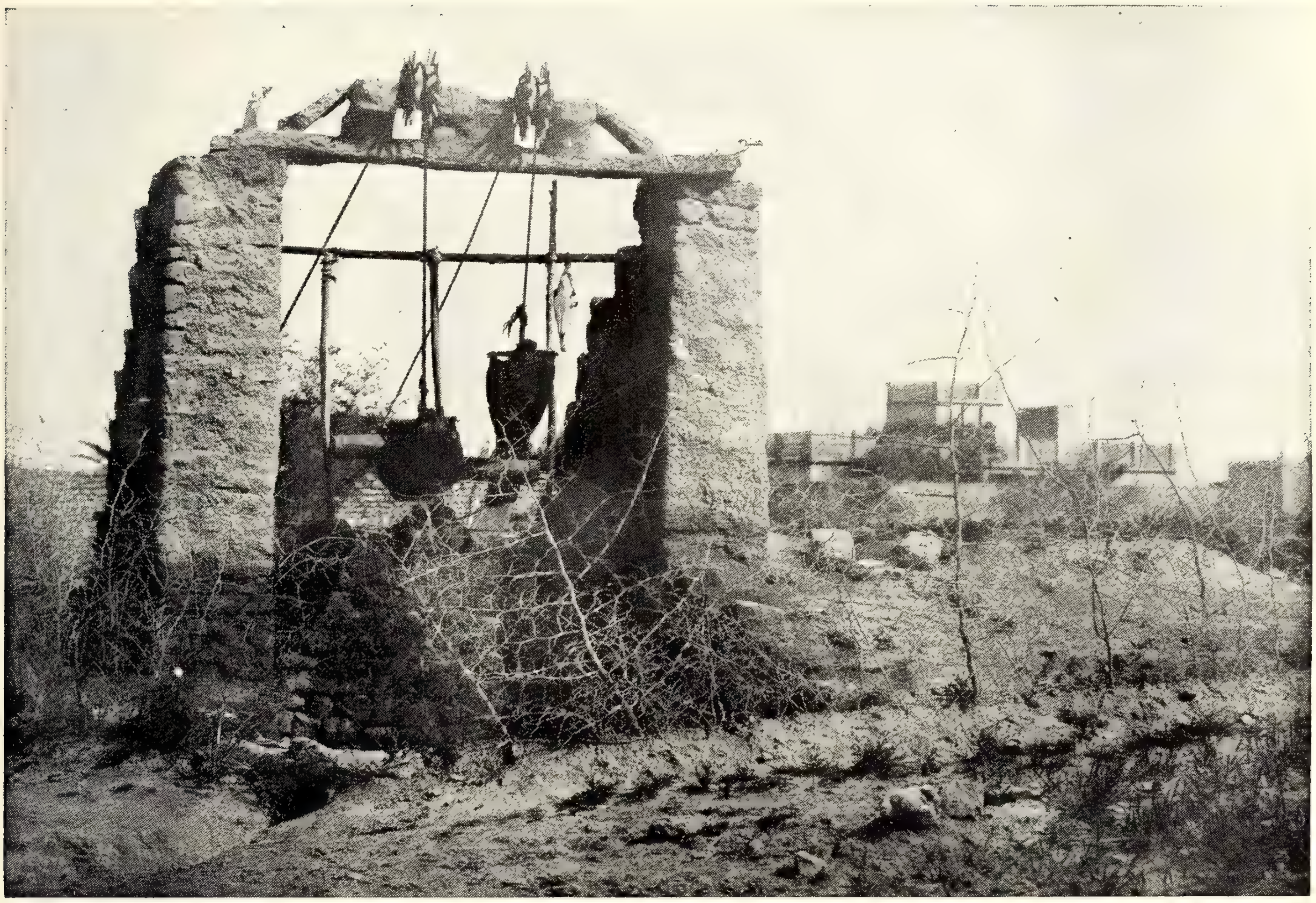


OUTLINE MAP OF OMAN



THE SULTAN SAYYID FEYSIL BIN TURKI, THE PRESENT RULER OF OMAN, WHO SUCCEEDED HIS FATHER JUNE 4, 1888

He is a progressive ruler, and the closest relations have existed for years between the government of India and his sultanate



ANCIENT WELL ON THE ROAD FROM MUSCAT INLAND

Showing the primitive method of drawing water by bullocks or donkeys in large skins for purposes of irrigation

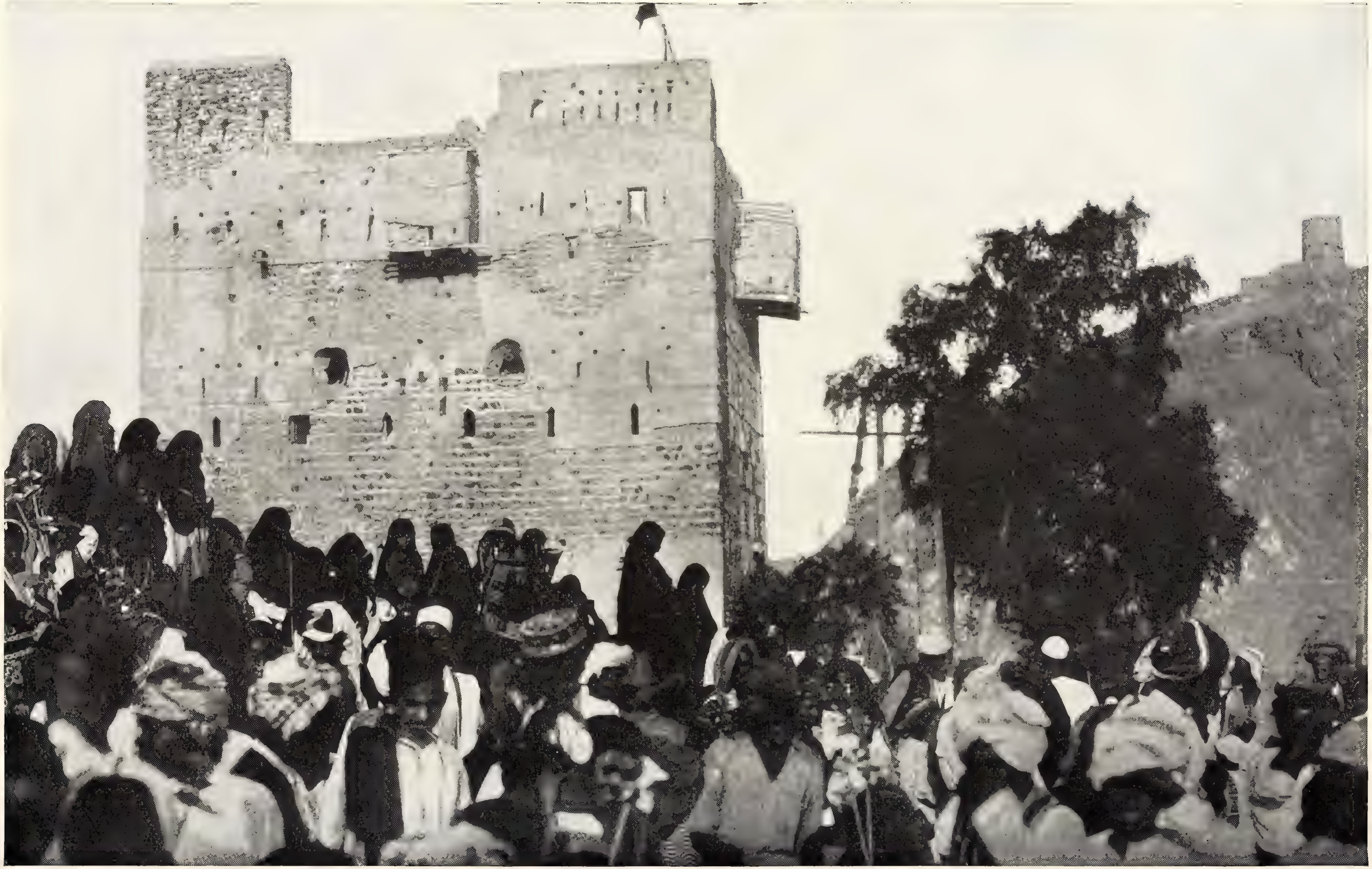
life and property when the tribes are at war. In recent years trade has greatly increased, and there has been considerable agricultural development. The mineral resources of the province are not well known, and a great portion of it is still largely unexplored.

Some years ago it was my privilege to cross from Abu Dhabi, on the Pirate Coast, through Bereima to Sohar, and also from Sharkah, on the Pirate Coast, to Shinas, in both cases traveling along the coast from Sohar to Muscat.

The Pirate Coast was formerly noted for the savage ferocity and fanaticism of its inhabitants. Sir John Malcolm wrote fifty years ago concerning the people: "Their occupation is piracy and their delight murder; they are monsters."

Thanks to English commerce and gunboats, these fanatic Arabs have become tamed. Most of them have given up piracy and turned to pearl-diving for a livelihood. Their black tents and rude dwellings have made room for four important towns. As the slave trade has always flourished until recent years, a large part of the population of Oman is of negro descent, and at least four distinct African languages are spoken in the bazaars of Muscat and among the slaves in the interior. I quote a paragraph from the account of my journey:

"We heard on every side that traveling in the interior of Oman was safe, so, after bargaining with camel-drivers, we secured two companions and five camels to take us to Sohar for the sum of twenty *rials,* or Arabian dollars. At 9 p. m. on May 20 we left, and, after a short rest at midnight to water the camels, marched until 9 o'clock the next day. By going as much as possible by star-light to avoid the heat, and resting during the day under some scraggy acacia tree or in the shadow of a Bedouin



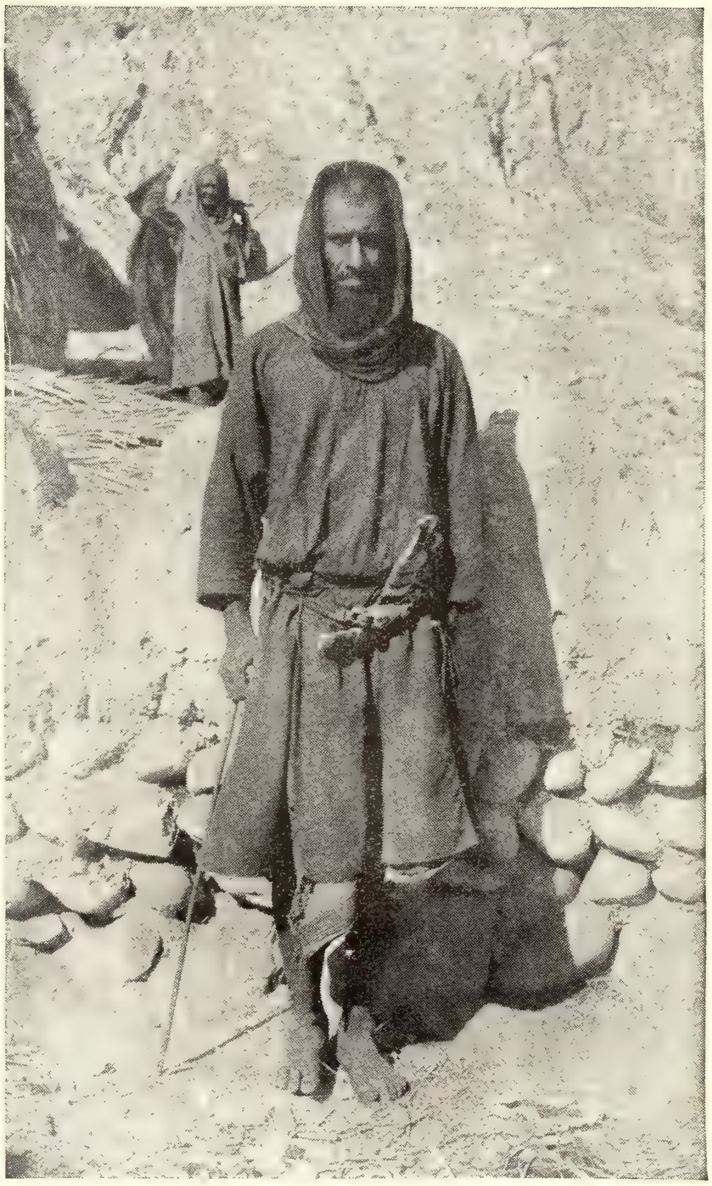
ONE OF THE CASTLES THAT GUARD MUSCAT AGAINST BEDOUIN INVASION FROM THE INTERIOR: THE SULTAN'S FLAG IS FLYING FROM THE RAMPARTS fort, we completed the distance of ninety-odd miles in a little over four days. A large part of the way we took was desert, with no villages or even nomad booths; the more usual route by Wady Hom being a little unsafe, we followed Wady Hitta.

"On the second day we passed villages and cultivated fields; that night we slept in the bed of the wady, surrounded by thousands of sheep and goats, driven in by Bedouin lasses from their mountain pastures. Even among these shepherds we found readers, and the colporteur sold books wherever the camels halted long enough to strike a bargain. It was late on Wednesday, May 23, that we entered the narrow pass of Hitta. Our guides preceded, mounted, but with rifles loaded and cocked; then followed the baggage camel, to which mine was 'towed,' and in similar fashion my companion on the milch camel, followed by its two colts.

"We were not troubled with the heat at night, but during the day it was intense, and it was refreshing to come to an oasis (common in this part of Oman), where water burst from a big spring and trees and flowers grew in luxury. In the mountainous parts of Oman the roads run almost invariably along the wady beds; sometimes these are sandy water-courses; again deep, rocky ravines or broad, fertile valleys. Vegetation generally is tolerably abundant. Tamarisks, oleanders, euphorbias, and acacias are the most common trees and shrubs.

"Where the country appears arid and sterile we were surprised to find a considerable population of shepherds and goatherds. Their dwellings are mere oval shanties constructed of boulders or rocks, and they subsist on their flocks. In the fertile valleys the population always centers in villages, and scarcely ever is a dwelling found at any distance from this common center. Here often are the fresh-water wells with the watch-tower to protect them.

"Just at the top of the pass of Hitta is the village 'Ajeeb, rightly named 'wonderful.' The view down the mountains over the fertile stretch of coast called El Batna and out over the boundless Indian Ocean was grand. We descended to the sea, and the turbulent mountain stream, so cold to our bare feet as we waded it in the early dawn, dwindled to a brook, and at last ebbed away along the beach, a tiny stream of fresh water. These perennial streams are the secret of the fertile coast all the way from Wady Hom to Birka."



NATIVE OF THE HILL COUNTRY OF OMAN

The whole country through which we passed, as well as the region north of Muscat, is capable of development if only there was a good government and intertribal warfare could be prevented. The Batna coast is the exception to all the maritime plains that surround so large a part of the Arabian Peninsula. In western and eastern Arabia these

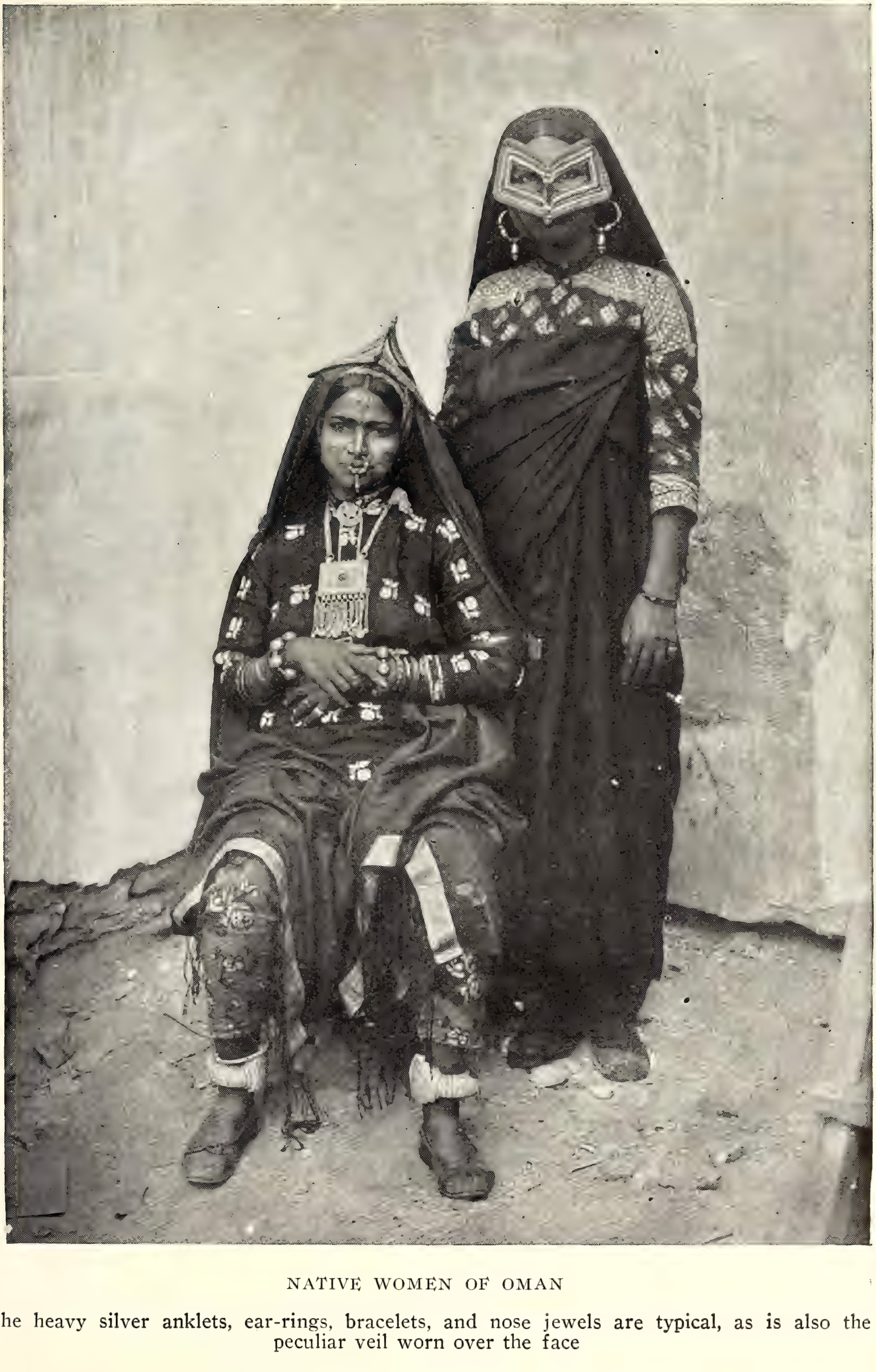
SON OF THE SULTAN OF OMAN ON A FULL-BLOOD ARAB HORSE UNDER A NUBUK TREE

sandy plains are nearly all barren, but from Muscat for 150 miles north date plantations and gardens extend almost to the ocean beach. Fresh water comes down from the high mountain ranges of Jebel Akhdar, and the Omanese Arabs are most successful in their primitive methods of irrigation.

The chief authorities on the interior of Oman were until recent date Niebuhr, Wellsted (1835), Whitelock (1838), Eloy (1843), and Palgrave (1863). Palgrave, however, only visited the coast, and his account of the interior and its history is pure romance. Later travelers, especially Colonel Miles (whose recent articles on Oman in the *Geographical Journal* are very valuable), my brother, Peter J. Zwemer, and Dr. James Cantine have visited the chief cities of Jebel Akhdar and corroborated the accuracy of Lieutenant Wellsted in his "Travels in Arabia."

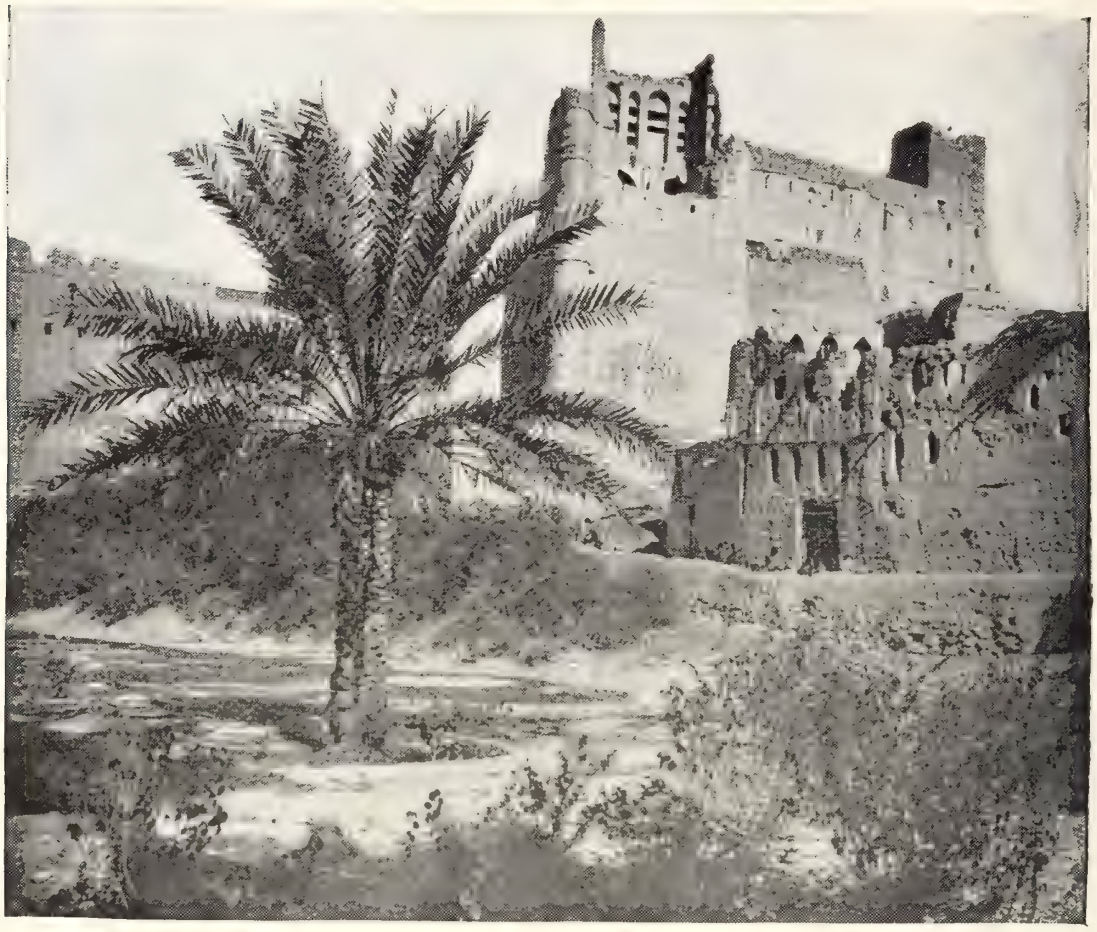
Although Colonel Miles reached the edge of the Oman Desert, all the country beyond is still largely *terra incognita.* No one has ever made the journey beyond the range of mountains or solved the mystery of western Oman, which is still a blank on the best maps; nor do we know anything of the land 100 miles southwest of Muscat save by Arab hearsay.

The most populous and fertile district of the highlands of Oman is Jebel Akhdar, which is also the best known. The fertility of this region is wonderful and in striking contrast with the barren rocks of so large a part of the coast. With a semi-tropical climate, an elevation of

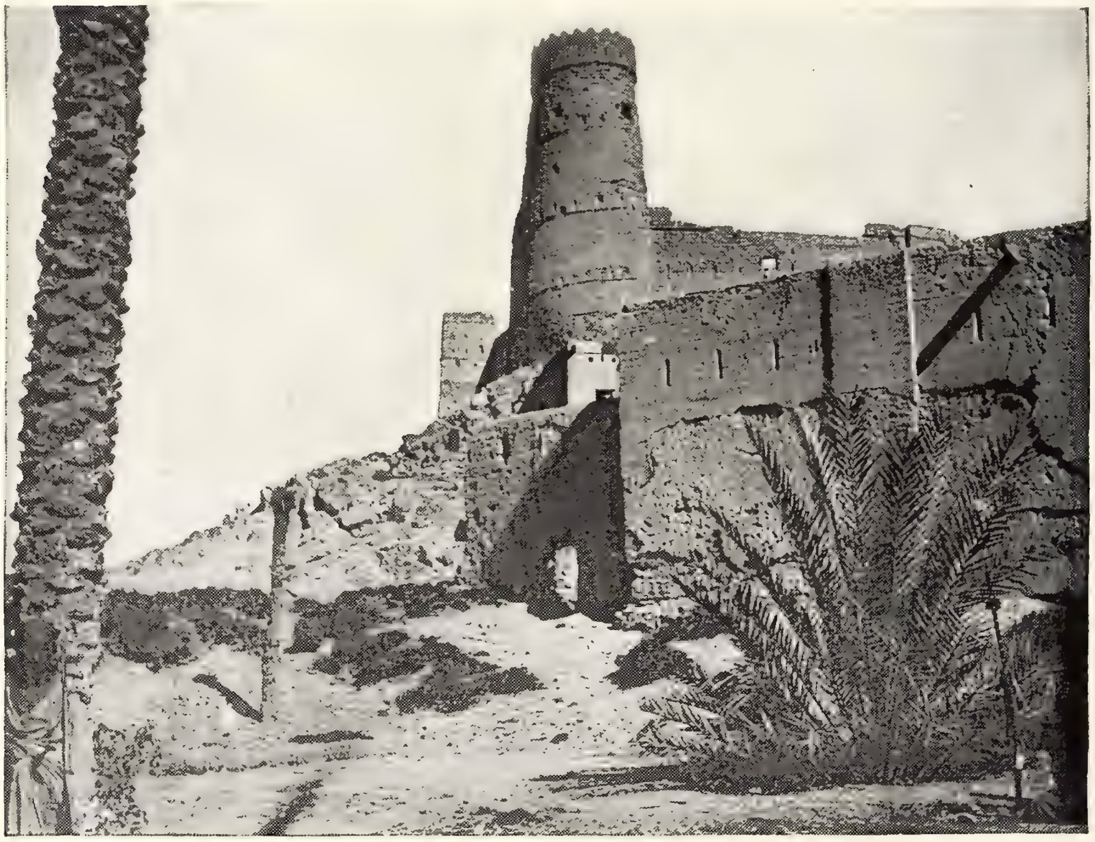


NATIVE WOMEN OF OMAN

The heavy silver anklets, ear-rings, bracelets, and nose jewels are typical, as is also the peculiar veil worn over the face

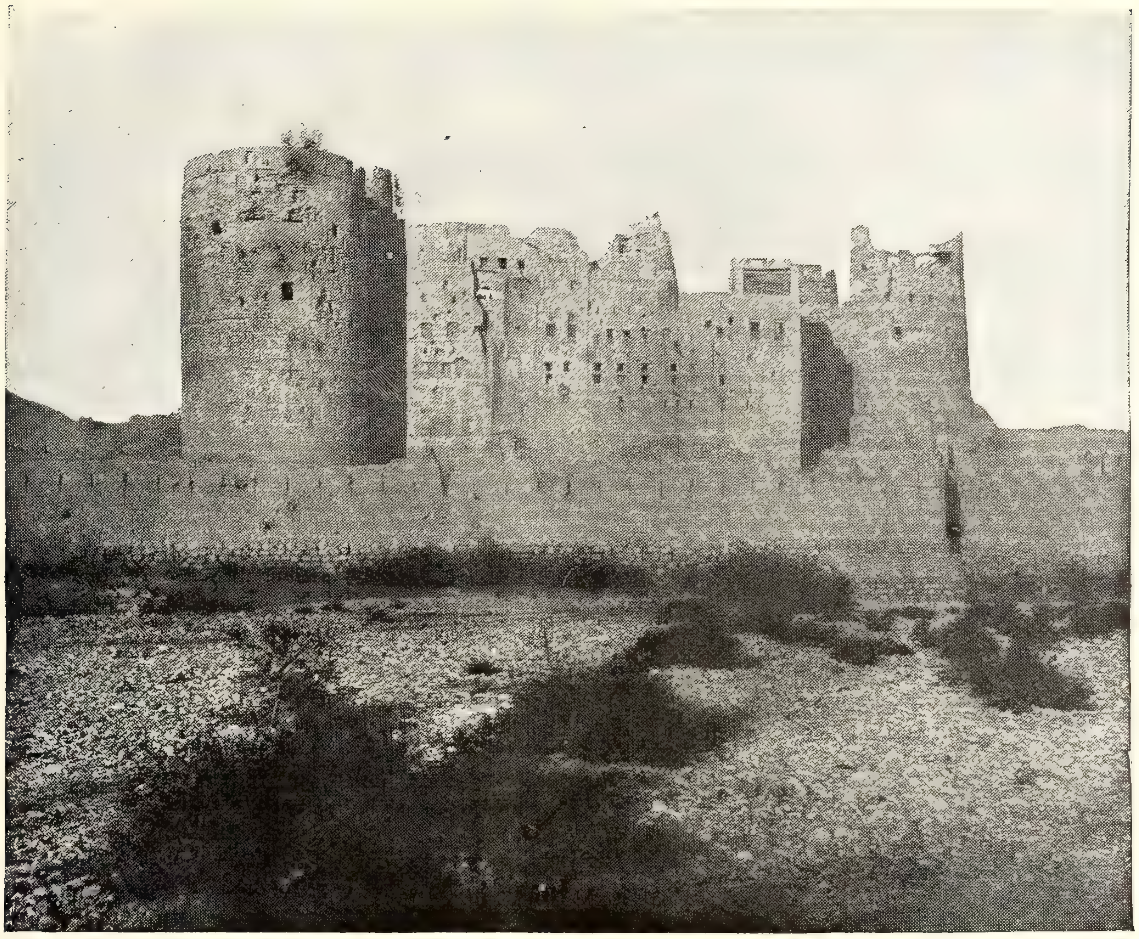


PART OF THE FORT AT BAHILA, IN OMAN



THE WIND TOWER ON THE FORT AT BAHILA

The town of Bahila during the fourteenth and fifteenth centuries was the capital of Oman. Its castle is a large, substantial, and handsome edifice, says Col. S. B. Miles, who visited the town some years ago. The castle is ornamented with two towers, one of which, probably the loftiest structure in Oman, is called the Wind Tower and has apartments in it for use in the hot season, when the open and elevated windows let in the welcome breezes from all quarters. Photos by Lieut. Col. S. B. Miles. From the *Geographical Journal,* London, England.



THE OLD FORT OR CASTLE AT ROSTAK

Photo by Lieut. Col. S. B. Miles. From the *Geographical Journal,* London, England.

3,000 to 5,000 feet, and abundant springs, the wadys and oases of Oman have awakened the delight and amazement of every traveler who has ventured to explore them. Water, the one priceless treasure in all Arabia, here issues in perennial streams from many rocky clefts, and is most carefully husbanded by the ingenuity of the people for wide irrigation by means of canals or water-courses called *faluj.*

Wellsted thus describes these underground aqueducts: "They are, as far as I know, peculiar to this country, and are made at an expense of labor and skill more Chinese than Arabian. The greater part of the surface of the land being destitute of running streams on the surface, the Arabs have sought in elevated places for springs or fountains beneath it. A channel from this fountain-head is then, with a very slight descent, bored in the direction in which it is to be conveyed, leaving apertures at regular distances to afford light and air to those who are occasionally sent to keep it clean.

In this way the water is frequently conducted for a distance of 6 or 8 miles, and an unlimited supply is thus obtained. These channels are about 4 feet broad and 2 feet deep and contain a clear, rapid stream. Most of the large towns or oases have four or five of these rivulets or *falj* (plural *faluj*) running into them.

The isolated spots to which water is thus conveyed possess a soil so fertile that nearly every grain, fruit, or vegetable common to India, Arabia, or Persia is produced almost spontaneously, and the tales of the oases will be no longer regarded as an exaggeration, since a single step conveys the traveler from the glare and sand of the desert into a fertile tract, watered by a hundred rills, teeming with the most luxurious vegetation."

Some of the photographs that illustrate this article were taken on a recent journey with Dr. Arthur K. Bennett, one of the medical missionaries of the American mission, and give a good idea of the general character of the country and the people. Except for the Pirate Coast, the Arabs of Oman are remarkably free from fanaticism, simple in their habits, and wonderful in their hospitality. Most of them belong to the Abadhi sect, which has many beliefs in common with Christianity, and the experience of our missionaries has been that the people are not only accessible, but willing to learn, and many of them eager not only for medical help, but for teaching.

PROTECTING OUR FORESTS FROM FIRE*

By Hon. James Wilson, Secretary of Agriculture

DURING the past season there were unusually severe forest fires in nearly every part of the country. The national forests suffered to a greater extent than at any time since their establishment.

The fires of 1910 were primarily due to a severe drought, which extended throughout the country and which in the Northwest was the most severe ever known, so far as official records show. The spring was very dry, and in the summer, when there are usually abundant rains in the mountains, the rainfall was exceedingly small and very localized. The region most affected was the area drained by the Columbia River, ex-

A FAVORABLE CONDITION FOR BURNING PILED BRUSH

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* From Secretary Wilson's Report for 1910.

A MOUNTAIN TRAIL BUILT FOR FIRE PATROL

The first object of the trail is to open up a forest and make it accessible for patrol and for fighting fires. The trails in the national forests are permanently constructed and are designed for saddle and pack horse travel. While their first purpose is to facilitate patrol and access to a fire, they may be used as starting points for back firing, and will often check or actually stop a small surface fire. Photo from Henry S. Graves, Chief U. S. Forest Service.

tending from the ocean to western Wyoming and Montana.

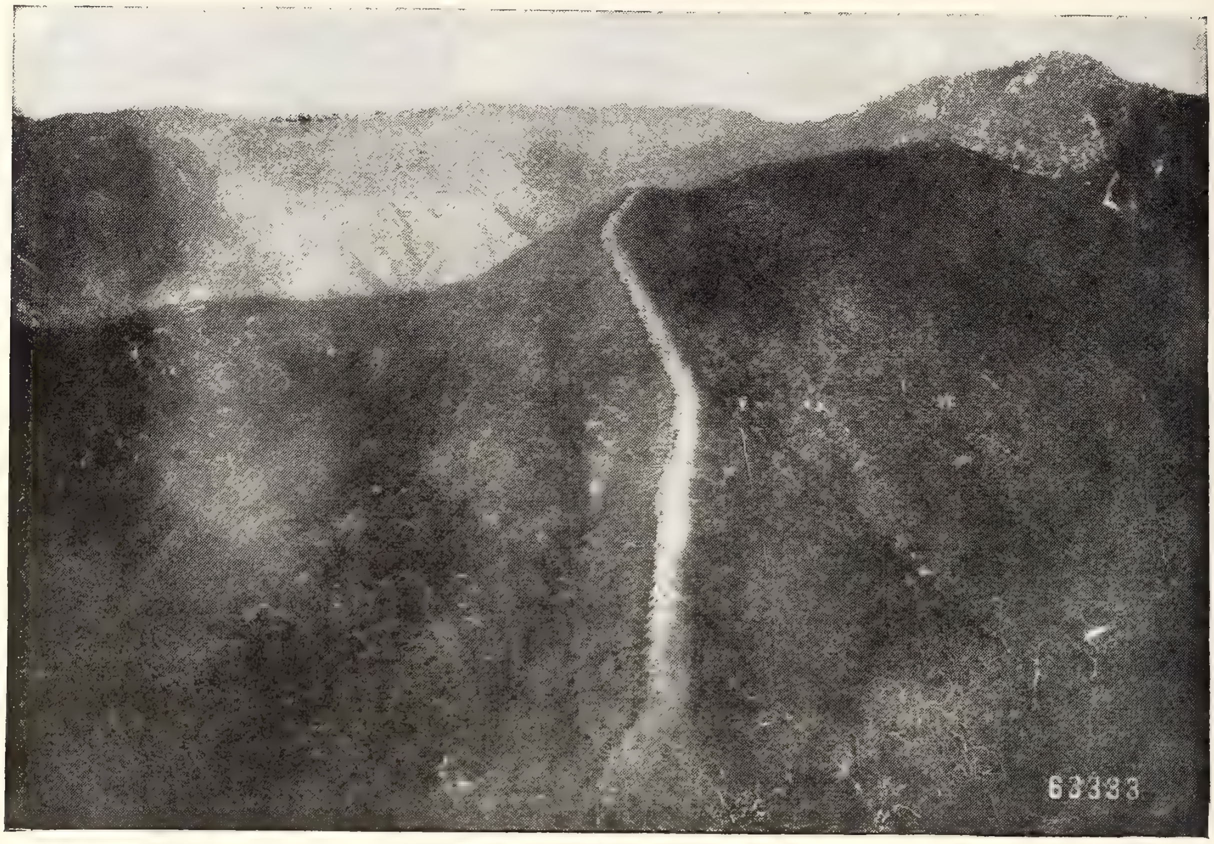
The effect of the drought was to render the forests very inflammable. Not only did the surface litter of leaves, branches, fallen logs, and other material become very dry, but the thick layer of vegetable mold in the deep, usually moist forests became like tinder.

In addition to the drought, the past season was characterized in many places by constant high winds, which rendered fire protection exceptionally difficult. The smallest escaping spark from a camp-fire or burning slash-pile was often enough to start a blaze, which, under the high winds, developed into a dangerous conflagration in an incredibly short time.

The worst fires occurred in northwestern Montana and Idaho and in eastern Oregon and Washington. Severe fires also occurred in California and the central Rocky Mountain region, but the conditions were not as difficult as in the North Pacific region and the fires were more easily controlled.

The entire forests of the northern Rocky Mountains were at one time threatened with destruction. Unless the fires had been checked, scores of towns and communities would have been wiped out and the lives and homes of thousands of people imperiled. I was confronted with the problem of either putting out the fires or being directly responsible for what would have been one of the worst disasters in the history of the country. Without hesitation I called upon the forest officers to stop the fires and to make such expenditures as seemed absolutely necessary to accomplish this result. Every source of help was called in. Temporary labor was employed where it could be secured. The War Department aided by sending troops. The railroad companies, lumber companies, and private individuals cooperated in the endeavor to avert a great disaster.

Early in September the flames were finally subdued. The fires which could be reached by roads and trails were



A FULLY CLEARED FIRE LINE IN THE SAN GABRIEL MOUNTAINS

The ideal fire line is a completely cleared strip, from which are removed not only the trees and brush, but also all ground débris down to the mineral soil. Such a line is especially necessary wherever fire will run swiftly and it may not be possible to reach the fire promptly with fighting appliances. A conspicuous example of the necessity of such fire lines and of the service rendered by them is found in the chaparral zone of the mountains in southern California, where the chaparral cover is of great importance in protecting the local watersheds. The area is large, the mountains are rough and difficult to travel, and fire runs with great rapidity. The government is therefore building extensive trails for patrol to prevent fires and supplementing them by wide, cleared fire lines to stop any fires that may start. Photo from Henry S. Graves, Chief U. S. Forest Service.

largely put out through the crews working under the forest officers. Those fires in the inaccessible areas were extinguished finally by the aid of timely rain and snow storms. While the aggregate loss of life and property was large and the cost of fighting the fires about a million dollars, I do not hesitate to state that if it had not been for the heroic and efficient work of the forest officers many millions of dollars' worth of public and private property would have been destroyed, and probably many lives would have been lost. I cannot commend too highly the self-sacrificing work of the local forest officers, who toiled day and night, week after week, risking their lives to save the forests.

The reports show that there were over 4,000 fires in the national forests during the season. Most of them were small and were promptly extinguished by the forest officers. Only about 15 per cent of the fires were responsible for the great losses. These occurred chiefly in the inaccessible regions where they could not be reached quickly because of the lack of roads and trails, or in areas inadequately patrolled. The greatest damage was done by the great fire of August 20 in northern Idaho. Many fires were burning at that time, but nearly all of them were under control and would shortly have been extinguished had it not been for a terrific hurricane which developed and swept all fires beyond control. Within 24 hours there was practically a continuous fire for a distance of over 100 miles.

The total area burned over during the

A FIRE LINE IN THE ADIRONDACKS

Where there are no roads or trails which will answer the purpose the Forest Service advocates the construction of special fire lines. These are necessarily expensive and are used only in woodlands in the better-settled portions of the country, where the property to be protected is very valuable.

season amounts to over 3,000,000 acres. While accurate data have not yet been received from all the forests, it is probable that between 6 and 7 billion feet of timber was killed. A portion of this can still be cut and utilized, so that it will not be a total loss. The damage in money cannot be accurately estimated until forest surveys are made, but it will probably reach over $25,000,000 if both merchantable timber and young growth are considered.

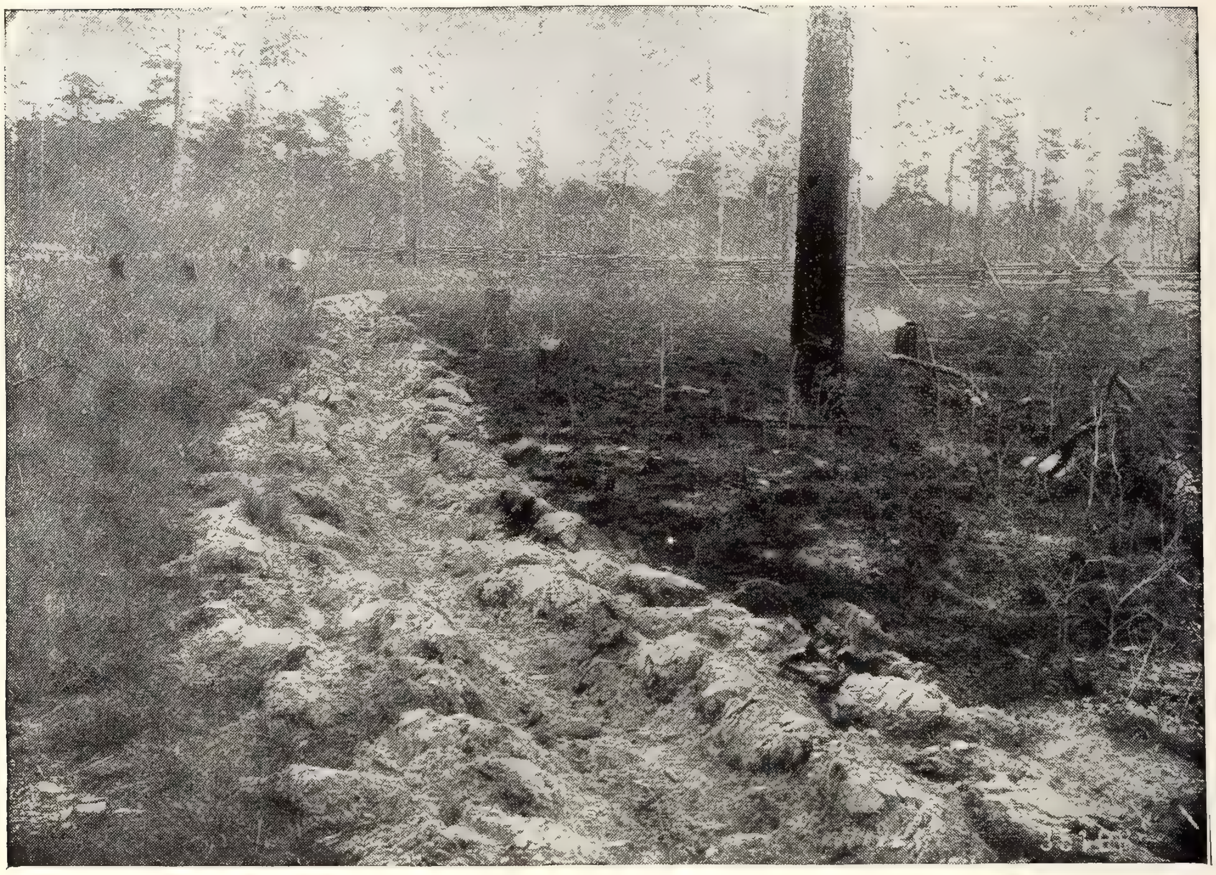
The cost of fighting the fires will aggregate a little over a million dollars. This is a large sum, but it represents considerably less than 1 per cent of the value of the property saved.

It is to be deeply regretted that there was a large loss of life through these fires. Altogether 76 persons in the employ of the Forest Service were killed in fighting the fires. That more were not killed was due to the skill and coolness of the forest rangers. Where relatives were found, the bodies were brought out and every help possible given to the families. There were 35 persons killed whose relatives could not be located.

There were a number of men injured more or less seriously. Unfortunately the law does not permit paying the expenses of the injured or their wages after they ceased their work. The hospital expenses of these men were met by private subscription. The Red Cross contributed $1,000. The remaining expenses, including expenses of interment of the dead, were borne by subscriptions from the forest officers and other members of the Forest Service.

HOW THE FOREST FIRES ARE STARTED

Railroads continue to be responsible for a large number of fires. This will continue to be the case until the locomotives are either equipped with efficient spark-arresters or oil is used for fuel. It should be said, however, to the credit of the railroads, that during the past



A PLOWED FURROW THAT STOPPED A SURFACE FIRE

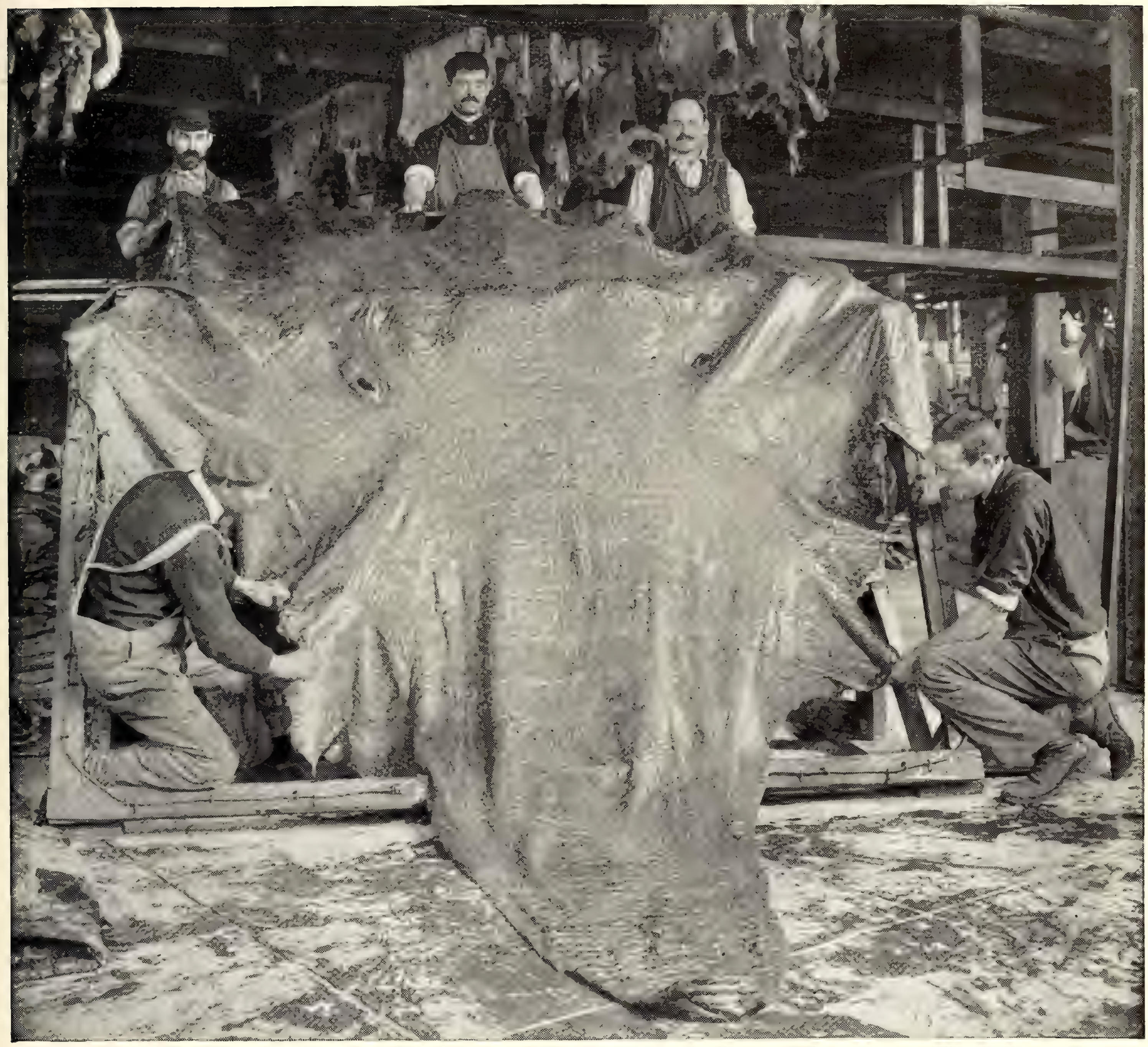
season many of them have taken an active part in assisting in the work of fire protection and fire fighting. The Chicago, Milwaukee and Puget Sound Railroad has installed oil-burning locomotives, and it is a striking fact that not a single fire has started from them, although the road traverses a long distance in the national forests.

A number of railroad companies have entered into coöperative agreements with the Forest Service to clear fire lines along the right of way and to employ special guards to patrol the tracks during the dangerous season. The effectiveness of the coöperative patrol by the railroads and the Forest Service was well illustrated in Montana and Idaho. Although a very large number of fires were started, most of them were extinguished before great damage was done. In some instances, however, no effective system of protection had been undertaken, and very damaging fires are chargeable to locomotive sparks.

One of the most prolific sources of fire and one which is uncontrollable is lightning. There are scattered throughout the forest innumerable dead trees and stubs. During the past season there were many electric storms unaccompanied by rain. In nearly every such storm some tree was struck and a fire started. These occurred frequently in very remote and inaccessible places and resulted in fires which were very disastrous, because they could not be quickly reached.

Many fires are chargeable to carelessness, especially in leaving camp fires and in burning slashings. A larger patrol service would prevent to some extent carelessness in the use of fire in the woods, but fundamentally there is required a better appreciation on the part of the public of the need of protection from fire.

The most regrettable fact is that there has been a considerable amount of incendiarism. While it is very difficult to prove that a given fire is of incendiary origin, circumstantial evidence has shown that many incendiary fires were started during the past season. The situation has been so serious that I have offered a reward for the conviction of incendiaries.



TANNED HIDE OF THE HEAD OF ONE OF THE ELEPHANTS SHOT BY MR. ROOSEVELT FOR THE U. S. NATIONAL MUSEUM

As the scientists could not find a "cask" large enough to contain an elephant's hide, they shipped it in five pieces. This is one of them. Although they scraped off as much from the inside of the skin as they could before shipping, this hide weighed 858 pounds when it arrived. These hides vary in thickness from three-eighths to one inch and are a tough proposition for the tanner. Photo from Crosby Frisian Fur Co., Rochester, N. Y.

OUR FOREST RESERVES NEED MORE TRAILS, FIRE LINES, LOOKOUT STATIONS AND EQUIPMENT

The first necessity in organizing a forest for protection from fire is to construct roads and trails in order that the different parts of the forest may be accessible both for patrol and for the mobilization of fire fighters. A forest in which there are inadequate means of communication cannot be fully protected under any conditions. Without trails it is impossible properly to patrol the forest; and, in case a fire is discovered, it cannot be attacked if there are no means of transporting quickly to it men and fire-fighting equipment. The roads and trails serve also as an aid in attacking fires. The work of constructing roads and trails has been pushed as fast as available funds permitted. There have been so far built about 5,500 miles

CHANGING THE TAN BATH FOR THE ELEPHANT

Hauling a part of the immense hide from one tan tub to another, in order to change and strengthen the liquor in which it is "tanned." From four to six months are required to properly tan the hide of an elephant, although they are a little more loose in fiber than the hides of the rhinoceros and hippopotamus, which are about the hardest proposition which the tanners have ever been called upon to tackle. One of the workmen has in his hand the elephant's hoof, which is 16 to 18 inches across. Photo from Crosby Frisian Fur Co., Rochester, N. Y.

of roads and 16,000 miles of trails. Yet this is only a beginning when the extent of the forests is taken into consideration.

In addition to roads and trails, it is necessary to construct special fire lines. These are cleared lines through the woods located at critical points to supplement the system of roads and trails for fire protection. They serve both to check fires and also as points from which to fight them. Fire lines are being built as rapidly as possible. The most extensive work has been carried on in southern California, where the protection of the chaparral forests is of great importance in protecting the water supply. Fire lines are also extensively built along railroad rights of way and around lumber operations. The burning of broad fire lines here and there at critical points in open yellow-pine forests has been undertaken and will be pushed with vigor.

A second necessity in the organization

"SKIVING" A PIECE OF ELEPHANT HIDE

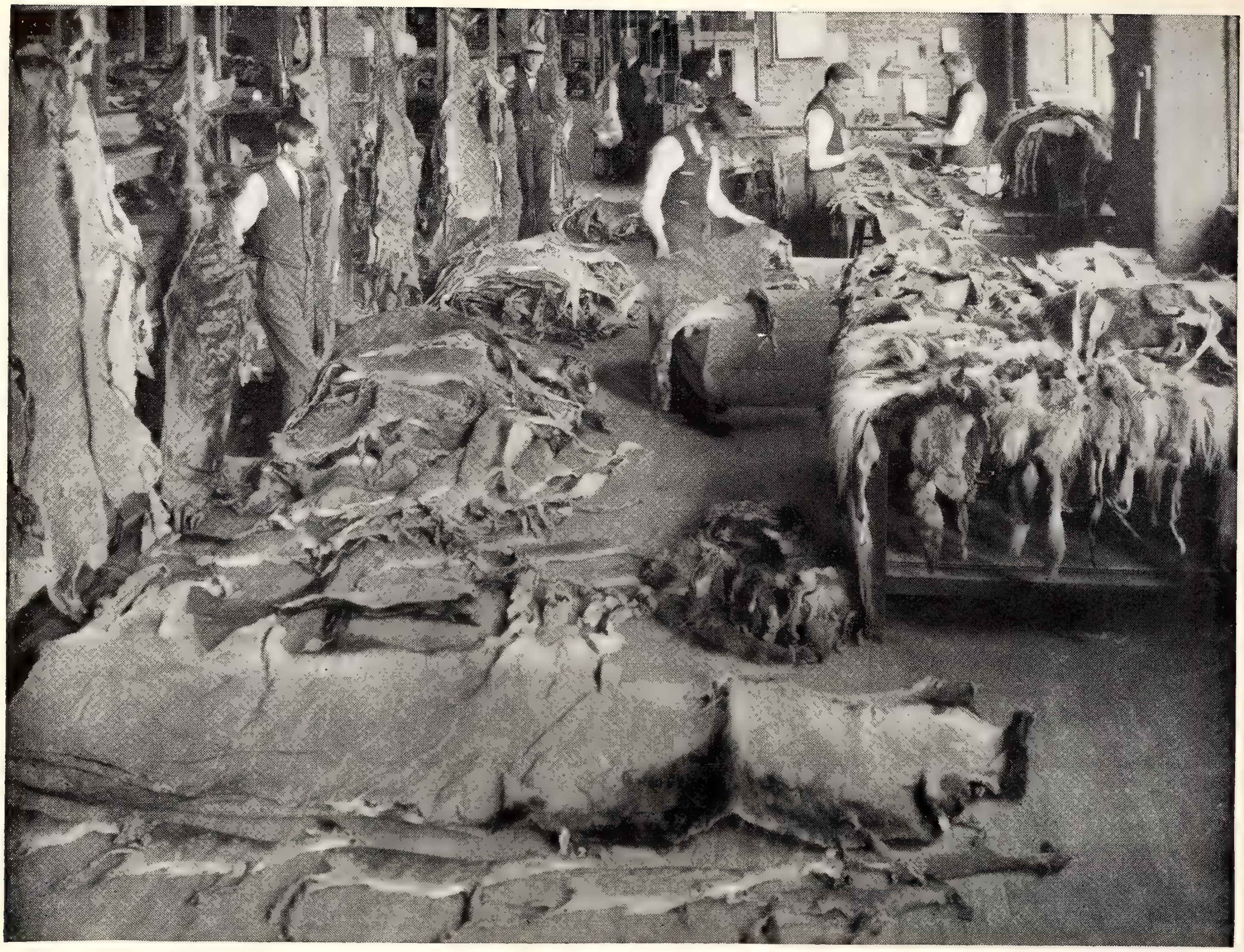
This picture shows the manner of "skiving," or shaving, the inside of a piece of elephant hide. With a sharp knife the extraneous matter and some of the inner thicknesses of the hide are pared away, leaving the skin thinner and much easier to work and mount. A skilled shaver will work hard the better part of a week on a big rhino, hippo, or elephant hide. Photo from Crosby Frisian Fur Co., Rochester, N. Y.

of the forest is a proper equipment for the prevention of fires and for fighting such as may be started. The most essential primary equipment is a system of telephone lines connecting ranger headquarters and lookout stations. The purpose of the telephone is to enable rangers and guards to give quick notice of fires and to secure such assistance as is required. There are already many instances where millions of dollars' worth of Government timber has been saved through the use of such telephone lines as have already been built. The total amount so far constructed comprises about 9,200 miles. The forests are still very meagerly equipped.

The forests should be provided, also, with lookout stations. These are usually located at high points, from which it is possible to look over a large area. At these lookout stations there should be at least a small building and a telephone. Frequently, where it has not been possible to build telephone lines, the lookout stations are provided with the heliograph and other means for signaling. Where the country is flat, watch-towers are built.

An essential part of the equipment of a forest is a system of properly located and well-equipped ranger stations. Many instances have occurred during this season where fires which threatened enormous damage were promptly extinguished because there was a ranger stationed within striking distance.

The equipment of the national forests



SORTING THE ROOSEVELT TROPHIES FOR SHIPMENT

Most of the hides in sight are those of East African antelope, of which 17 varieties are represented. In the foreground is seen the hide of a giant eland, and in front of it are stretched several hides of the tiny "dik-dik," the smallest animal in the world with a split hoof. There are about 200 of the antelope hides. On the table at the right is a pile of many varieties of monkey skins, great and small. There is no African collection in the world in numbers or quality equal to the remarkable series of big and little game which Mr. Roosevelt and the scientific members of his party obtained for the U. S. National Museum. The white rhinos (with the exception of two poor specimens in Berlin and London), the reticulated giraffe, the giant elands, and several of the antelopes are the only specimens of these animals possessed by any museum. The expense of securing this extraordinary series was paid entirely by Mr. Roosevelt and by private individuals, who have thus presented to our National Museum one of the most generous and priceless gifts the American people have received. Photo from Crosby Frisian Fur Co., of Rochester, N. Y.

should comprise also an ample supply of tools necessary in fighting fires. A beginning has been made in the establishment of small equipment stations here and there along the roads and trails, consisting of small buildings or toolboxes containing axes, shovels, grubhoes, water-buckets, ropes, etc.

The danger of the recurrence of such disasters as that of last summer's fires should be reduced to a minimum. Though it was unpreventable under the conditions of the year, the day will come when it would be counted preventable, and when under similar conditions it would generally be prevented.

Not to extend the existing permanent improvements as fast as opportunity is given would be criminal. The Forest Service is powerless to provide them except as means are put at its disposal. Expenditures for equipping the forests with roads, trails, telephones lines, fire lines, and other improvements can be made only from the permanent improvement fund. In the years 1907 to 1911 Congress made available a total for this purpose of $1,975,000. The amount available in 1910 was $600,000; in the current year it is $275,000. There are now on file carefully considered plans for specific permanent improvements calling for an amount of work which the entire appropriation for the Forest Service last year would hardly have paid for. In view of the facts, I consider it my duty to ask for a substantial increase of the permanent improvement fund.

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THE NATIONAL GEOGRAPHIC MAGAZINE

THE SNAKE DANCE

BY MARION L. OLIVER

IT was after a hot day's march across the desert that I had my first glimpse of Oraibi, one of the pueblo towns of the Hopi Indians. It looked like some gigantic fortress, looming in the distance above miles and miles of desert sand.

As we rode nearer we saw that at the foot of the great rock on which the town was built were little patches of corn and a few peach trees, tiny gardens which looked parched and stunted in the hot sun of the desert. We pitched our camp at the foot of the mesa and spent the night waiting in great excitement for the morrow, when we were to see the greatest religious ceremony of the Hopis, the Snake Dance, which takes place only every two years, and for which we had come so far. The dance was to take place at the hostile village, "Ho-Ta-Vila," 7 miles beyond Oraibi. This village to many is more interesting than the other older towns, for there missionaries are not welcome, schools do not exist, clothes are not thought necessary, and the old faith of the Hopis is guarded and taught with care by the Antelope and Snake priests.

At last morning came, and at the first notes of the reveille I was up. My tent was open and even from my blankets I could see in the dim morning light the great wall of the mesa, several hundred feet high, with the Hopi village on top, frowning at the white men who had come to see the sacred ceremony of the Hopi nation. Although it was very early, I could hear from time to time songs and voices floating down on the chill morning air; evidently the village was wide awake. The time passed all too slowly, and breakfast and the regular camp routine seemed unending.

At last 11 o'clock came, and, mounting our horses, we started for what proved a most thrilling experience. We had to ride up a very hard trail over the mesa, through Oraibi, and on over the desert on the other side. The trail was filled with both Navahos and Hopis on little underfed Indian ponies, all on their way to see the "big medicine." Soon the hostile village, Ho-Ta-Vila, was reached. Everywhere there was a feeling of intense excitement, and already the roofs of the adobe houses surrounding the tiny plaza were being covered with gaily dressed squaws and little naked children, looking like tiny mahogany cupids.

We found a cool spot in the shadow of a house and ate our luncheon before exploring the village. The village was delightfully foreign, and I had to keep pinching myself to make sure that it was not all a dream. The doors of the low adobe houses were open and one could

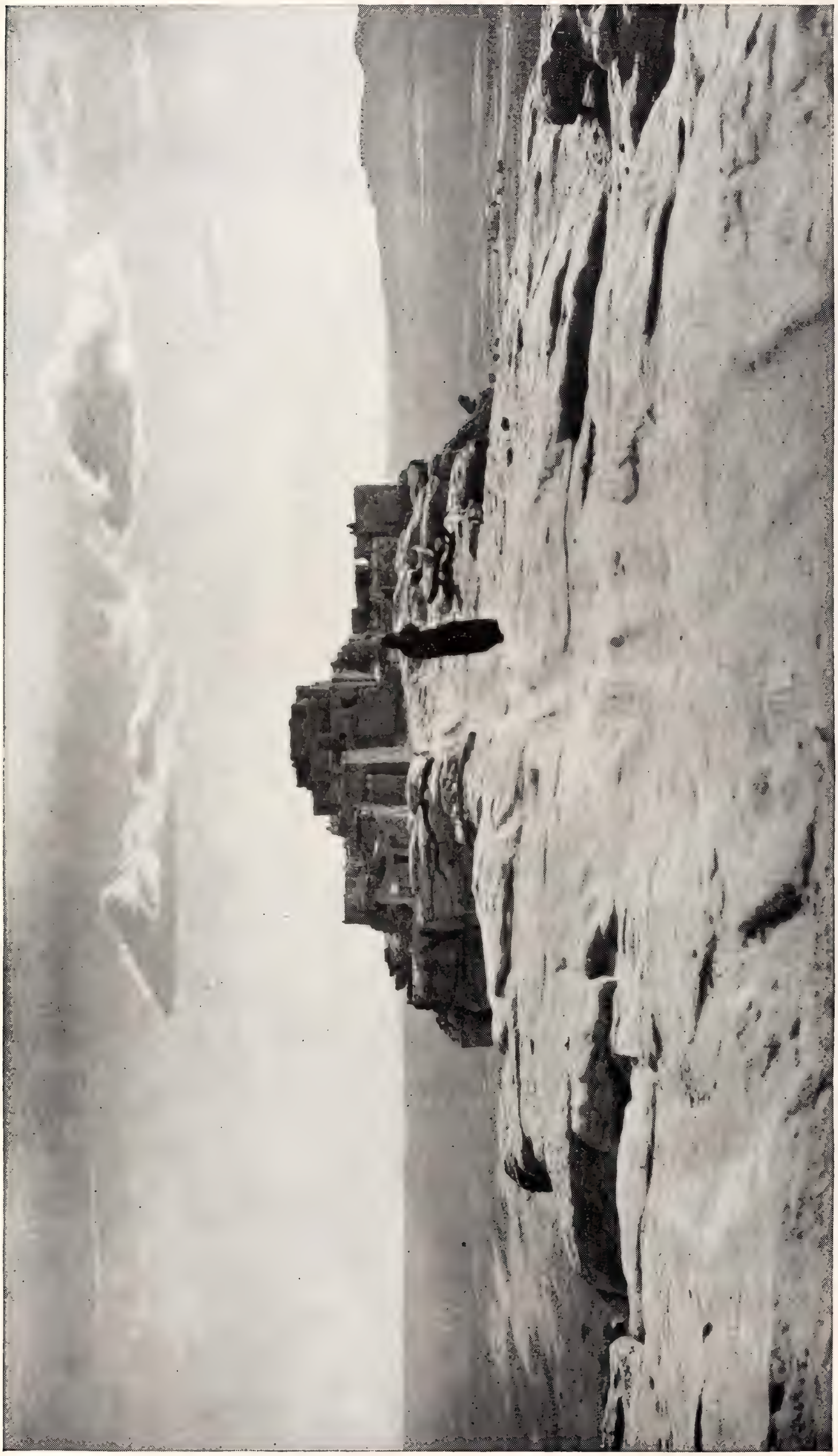


Photo by Mrs. Herbert Wadsworth

A TYPICAL PUEBLO IN HOPILAND, WALPI, PERCHED ON A TOWERING MESA IN A WIDE EXPANSE OF DESERT

All the Hopis are mesa dwellers, their villages being situated on great rock tables, which rise hundreds of feet above the surrounding desert, and can be reached only by steep, precipitous trails

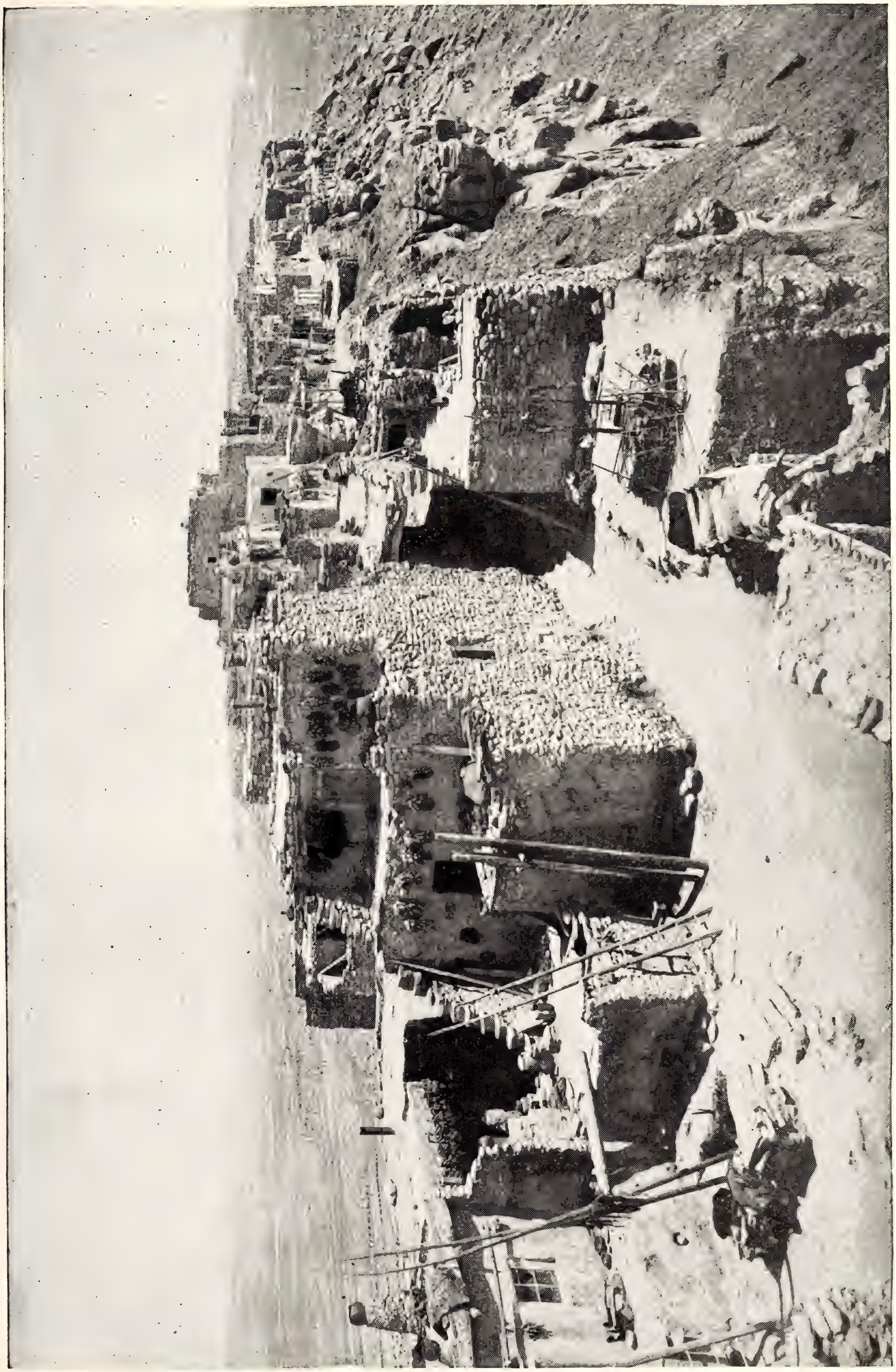


Photo by A. C. Vroman, of Pasadena, California

ANOTHER VIEW OF THE PUEBLO OF WALPI, ON A MESA A FEW MILES FROM ORAIBI

Photo by Mrs. Herbert Wadsworth

"Oraibi looked like some gigantic fortress, looming in the distance above miles and miles of desert sand. We pitched our camp at the foot of the mesa."

look in without feeling that one was prying.

In one house I saw the village ceremonial hair-dresser doing the young maiden's hair, for unmarried maidens do their hair in a style of their own, in a big round coil over each ear, to represent the squash blossom.

In another doorway was a young squaw with the fattest and brownest baby I have ever seen. He was as naked as the day he came into the world, and was eating, much to my horror, a melon almost as big as himself.

The next house I looked into I received quite a shock, for, instead of seeing some Indian child or some home scene, a little gray burro's face looked back at me. He seemed quite at home in the room.

Along the outer edge of the village were little corrals, and there were many more burros and many sheep. We walked past the kivas, or underground chapter houses, of both the Antelope and Snake clans, but were not allowed to look, much less to go down, as the priests were praying and preparing themselves for the dance.

I found some one who understood the origin and meaning of the dance, and, returning to the plaza, we climbed up on one of the near-by roofs, from which we had a splendid view of the tepee-like altar of green leaves, and could look beyond over the roofs to the great ladder leading out of the Snake kiva, and beyond again over the edge of the mesa, over miles and miles of desert sand, to the distant blue San Francisco Mountains. While waiting for the ceremony to begin, he told me somewhat of its origin and religious meaning.

"It seems that the Hopis believe that long, long ago all mankind came up from the lower world to the earth's surface through a part of the Grand Canyon of the Colorado River. As the various families emerged, some went north, some south, and some west and east. Those that went north, the Hopis, were driven back by fierce cold which they encountered, and built themselves houses at a place called To-ko-na-bi. But, unfortu-

Photo by A. C. Vroman, of Pasadena, California

"At the foot of the great rock on which the town was built were little patches of corn and a few peach trees, tiny gardens which looked parched and stunted in the hot sun of the desert."

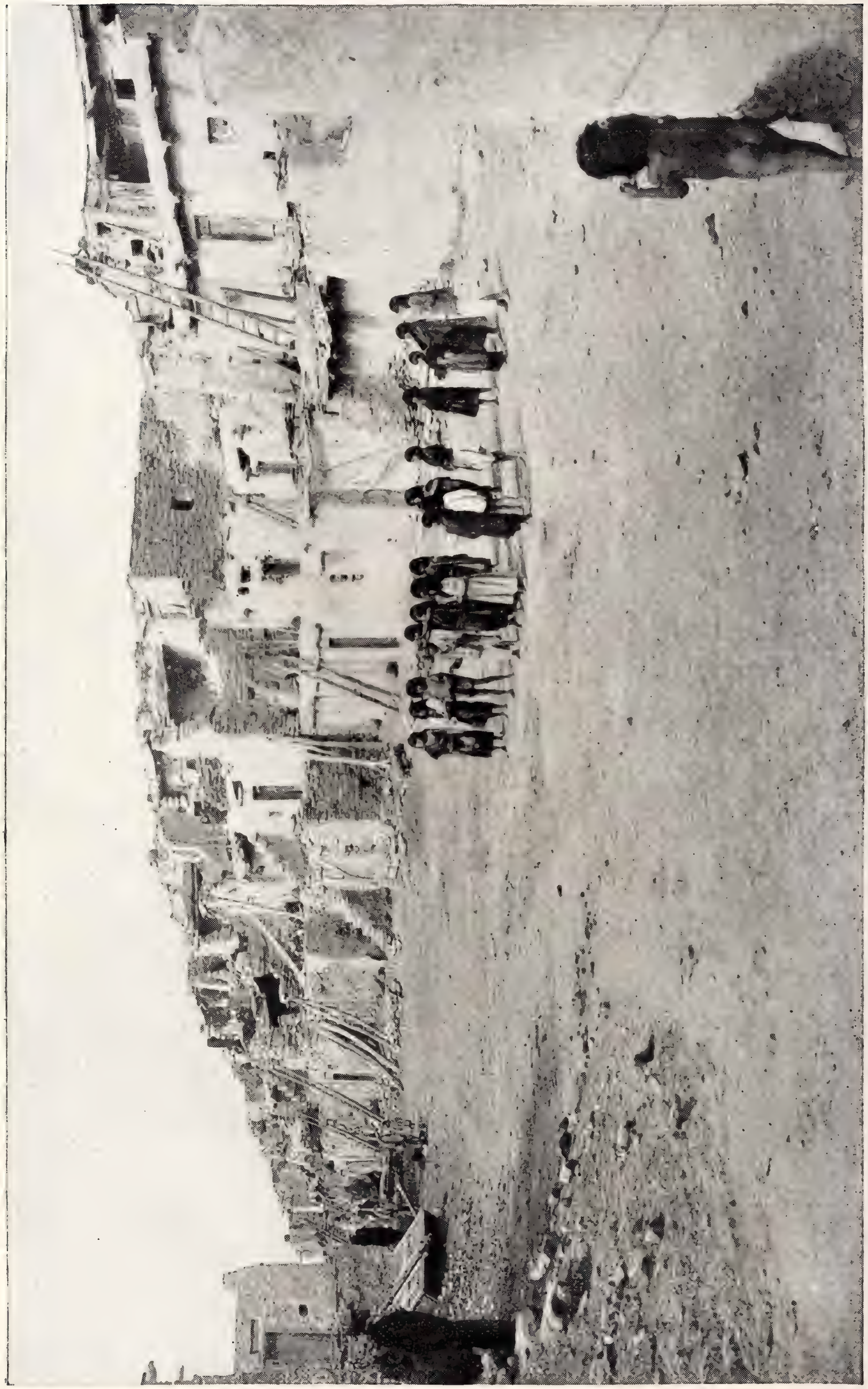
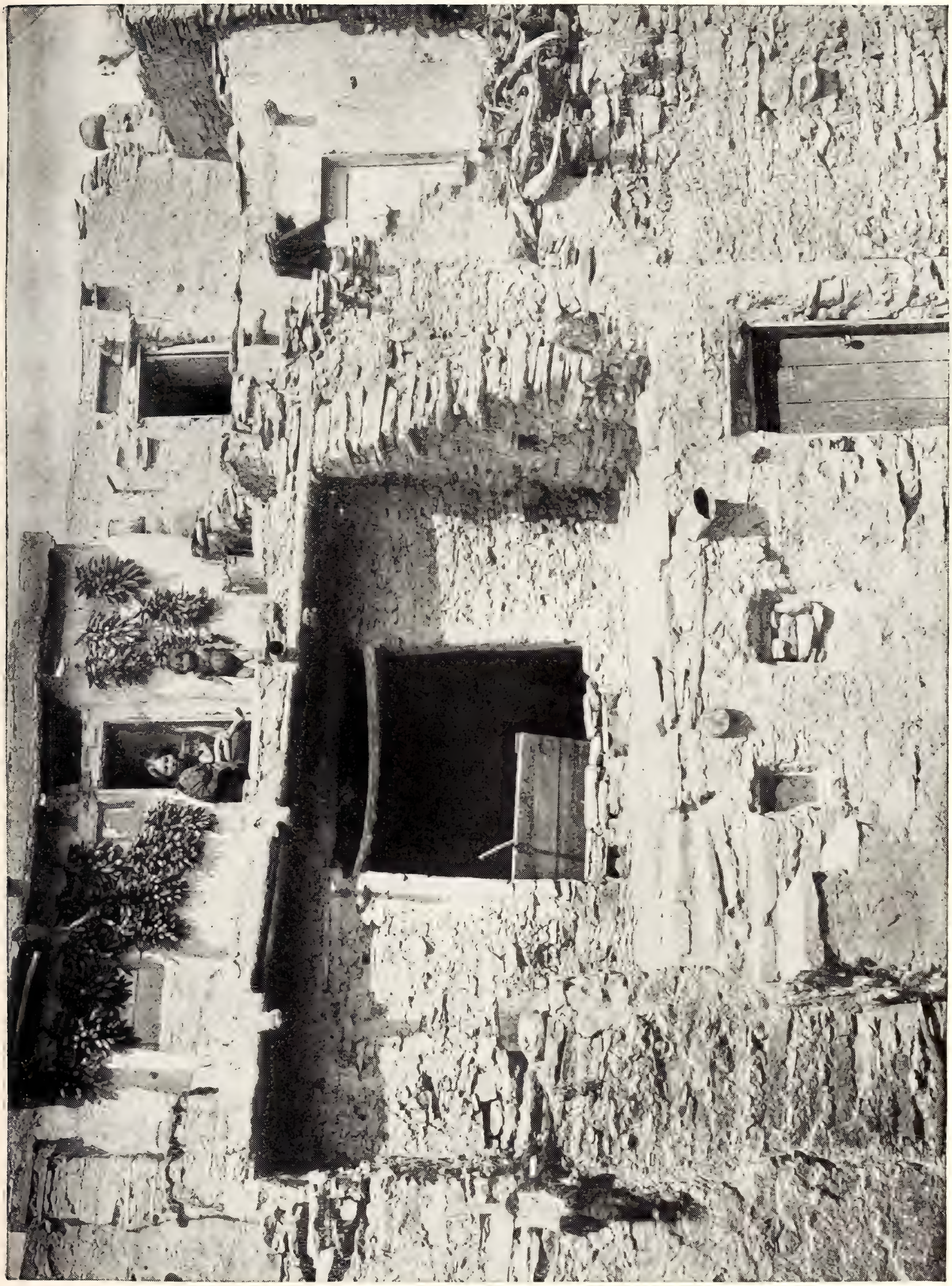


Photo by A. C. Vroman, of Pasadena, California

A STREET IN ORAIBI



A THREE-STORY HOUSE AT ORAIBI

Photo by A. C. Vroman, of Pasadena, California

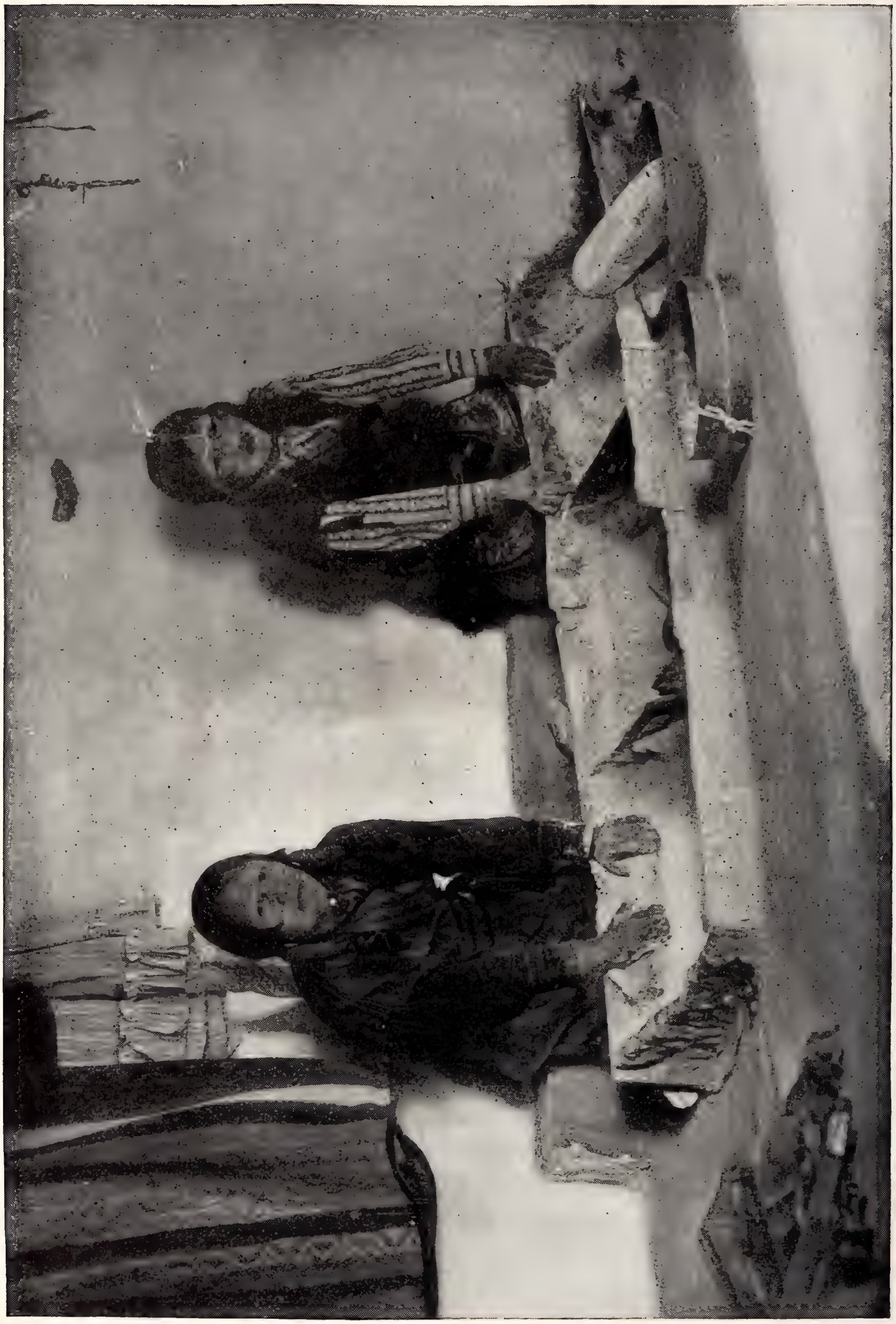
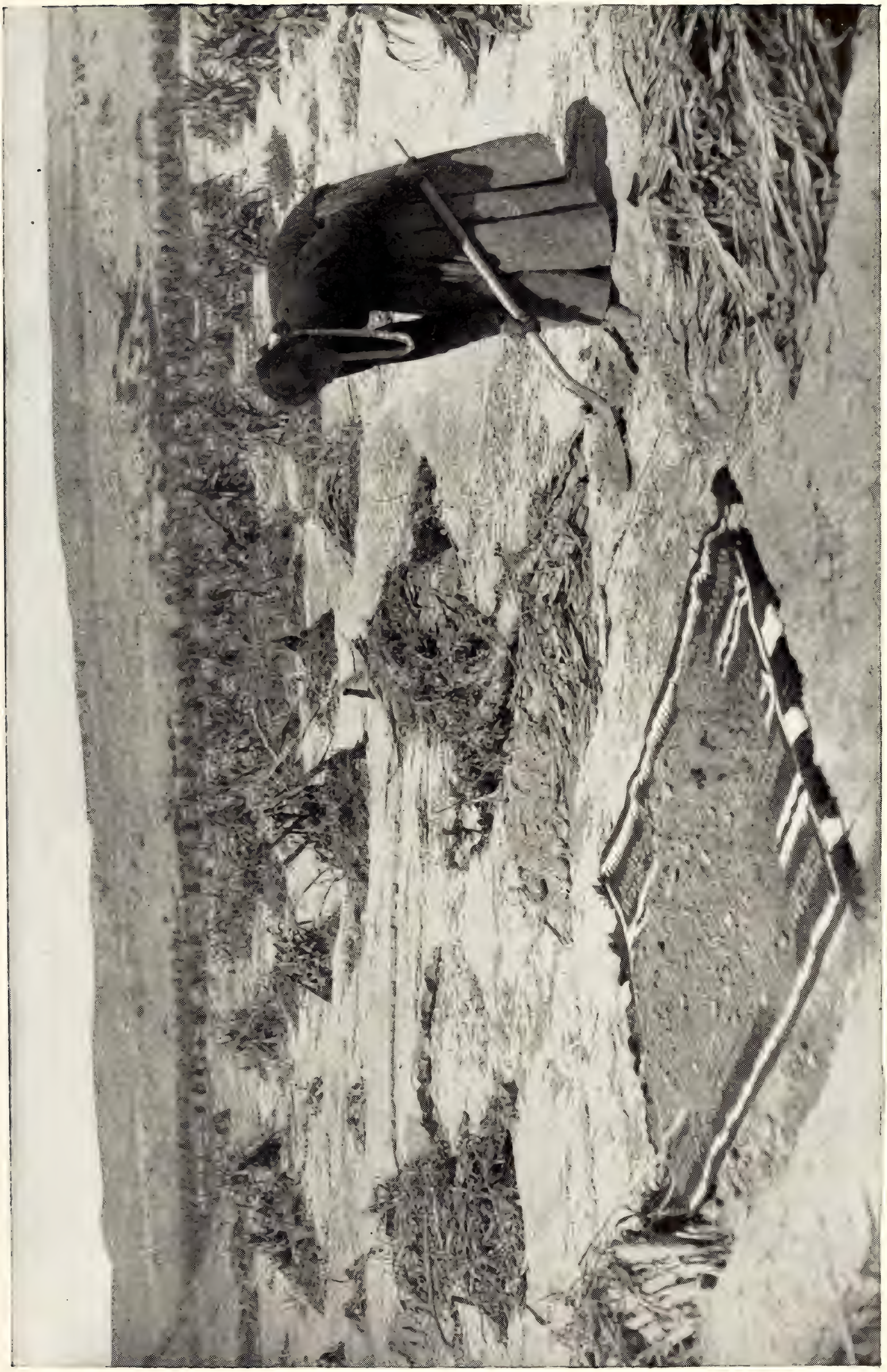


Photo by H. E. Hoopes, of Media, Pennsylvania

GRINDING CORN AT ORAIBI



CLEANING A NEW BLANKET IN HOPILAND

Photo by A. C. Vroman, of Pasadena, California

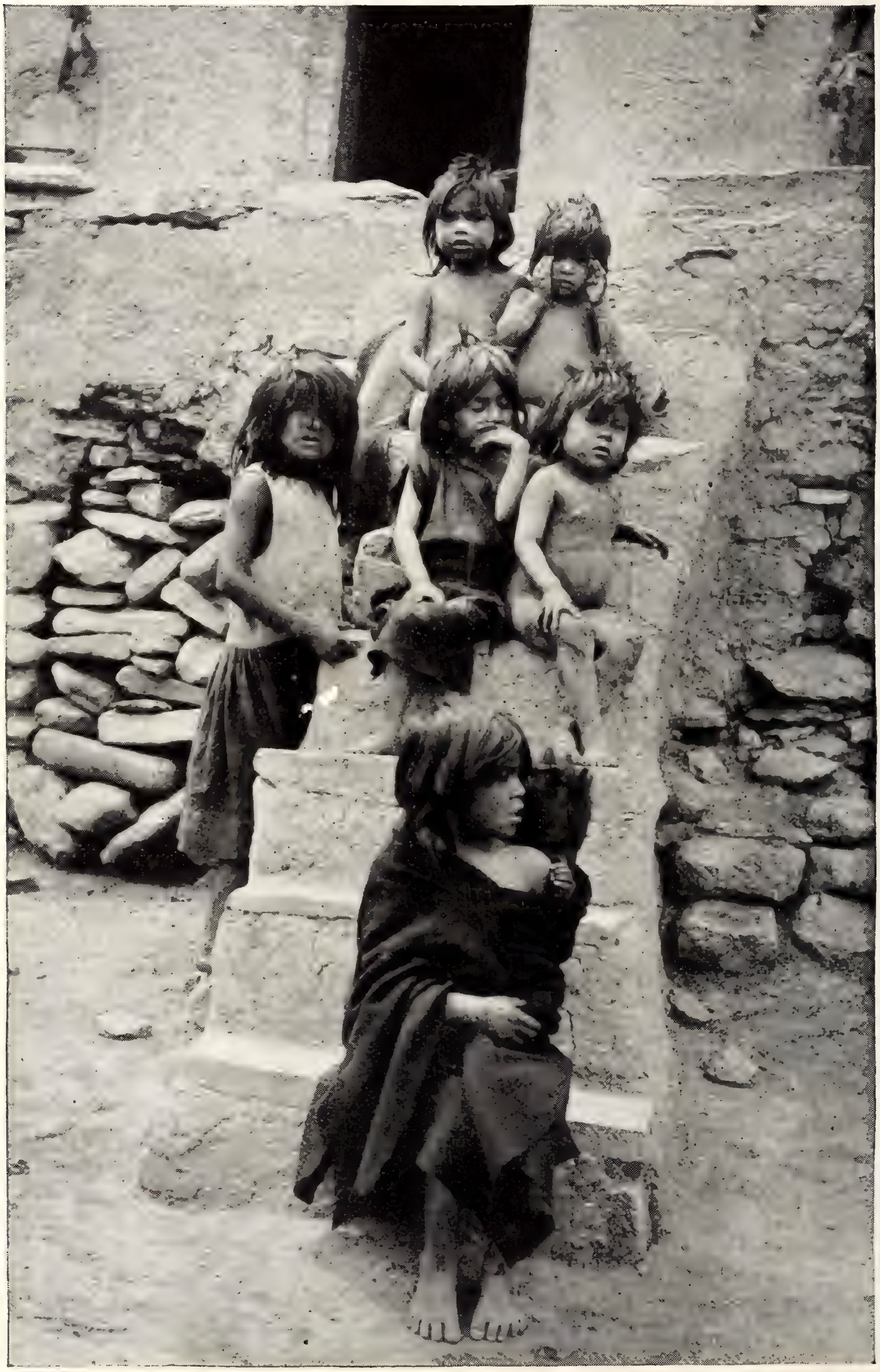


Photo by A. C. Vroman, of Pasadena, California

ON A DOORSTEP: ORAIBI

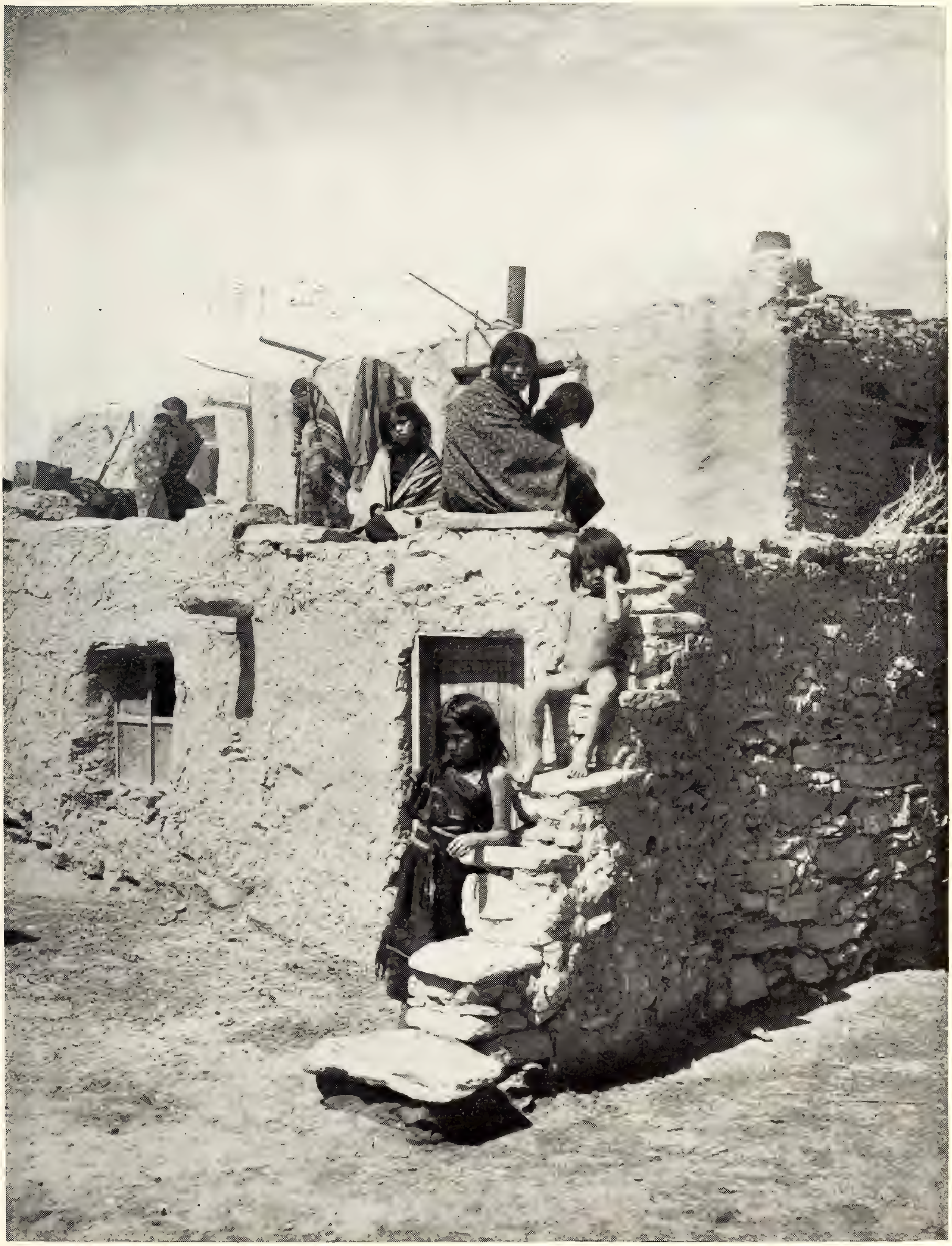


Photo by H. E. Hoopes, of Media, Pennsylvania

SCENE IN ORAIBI

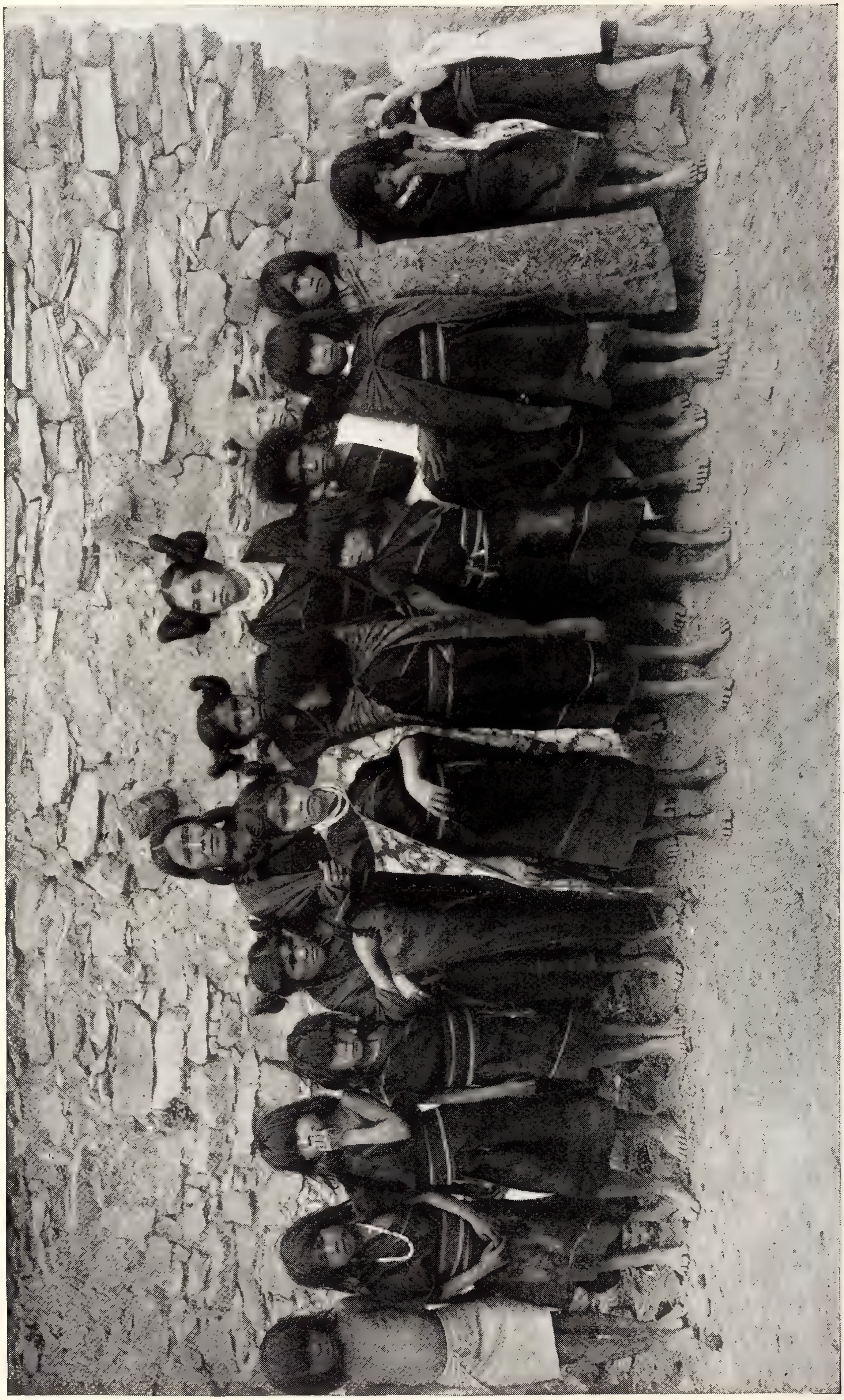


Photo by A. C. Vroman, of Pasadena, California

GIRLS OF HOPILAND

Photo by A. C. Vroman, of Pasadena, California

CHILDREN OF ORAIBI

nately, this was a desert place, where no rain fell and the corn could not grow.

"The chief of this village had two sons, the elder of whom, 'Tigo,' resolved to return to the underworld where he could learn of the gods how to be always assured of their favor. He made for himself a coffin-like boat of a hollow tree, into which he sealed himself and was thrown into the Colorado River, which he was convinced would carry him down to the home of the gods. His rude boat dashed down the rapids and over the falls into the secret bowels of the earth.

"At last it came to a stop, and Tigo, looking out of his peep-hole, saw the Spider Woman, who invited him to enter her house. The Spider Woman is a great personage in the Hopi faith. She it is who catches the clouds into her web in the heavens and makes the rain possible. Tigo accepted her invitation and she gave him the power of invisibility. She led him to descend still lower into the earth, until he reached the Snake-Antelope people. Here he was received with great cordiality and learned all the necessary ceremonies for making the rain-clouds come and go, the ripening winds to blow, and order the coming and going of the animals.

"With words of affection the chief of the Snake-Antelope clan gave him many things from both the kivas, and also two maidens, both of whom knew the snake-bite charm liquid, and instructed him that one was to be his wife and one the wife of his brother, to whom he must bring her in safety. Then, finally, he gave him the sacred standard, 'the tiponi,' and told him that it must be revered and protected, and in all his prayers and worship it must be at the head of his altar, or his words would not reach 'Those Above.'

"Tigo now started on his homeward journey, and when he reached the Spider

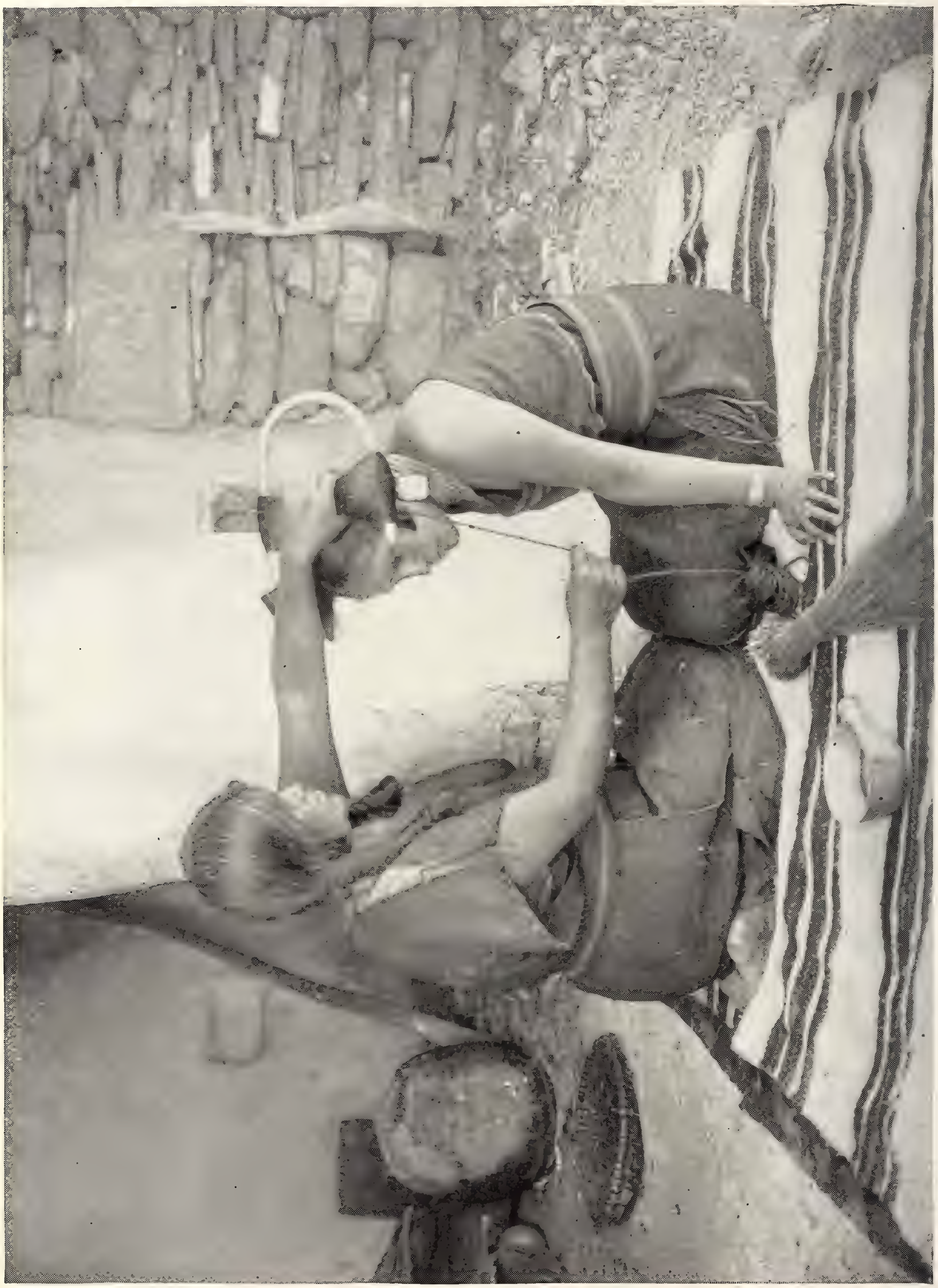


Photo by P. G. Gates, of Pasadena, California

DRESSING THE HAIR OF A HOPI MAIDEN FOR THE SNAKE DANCE

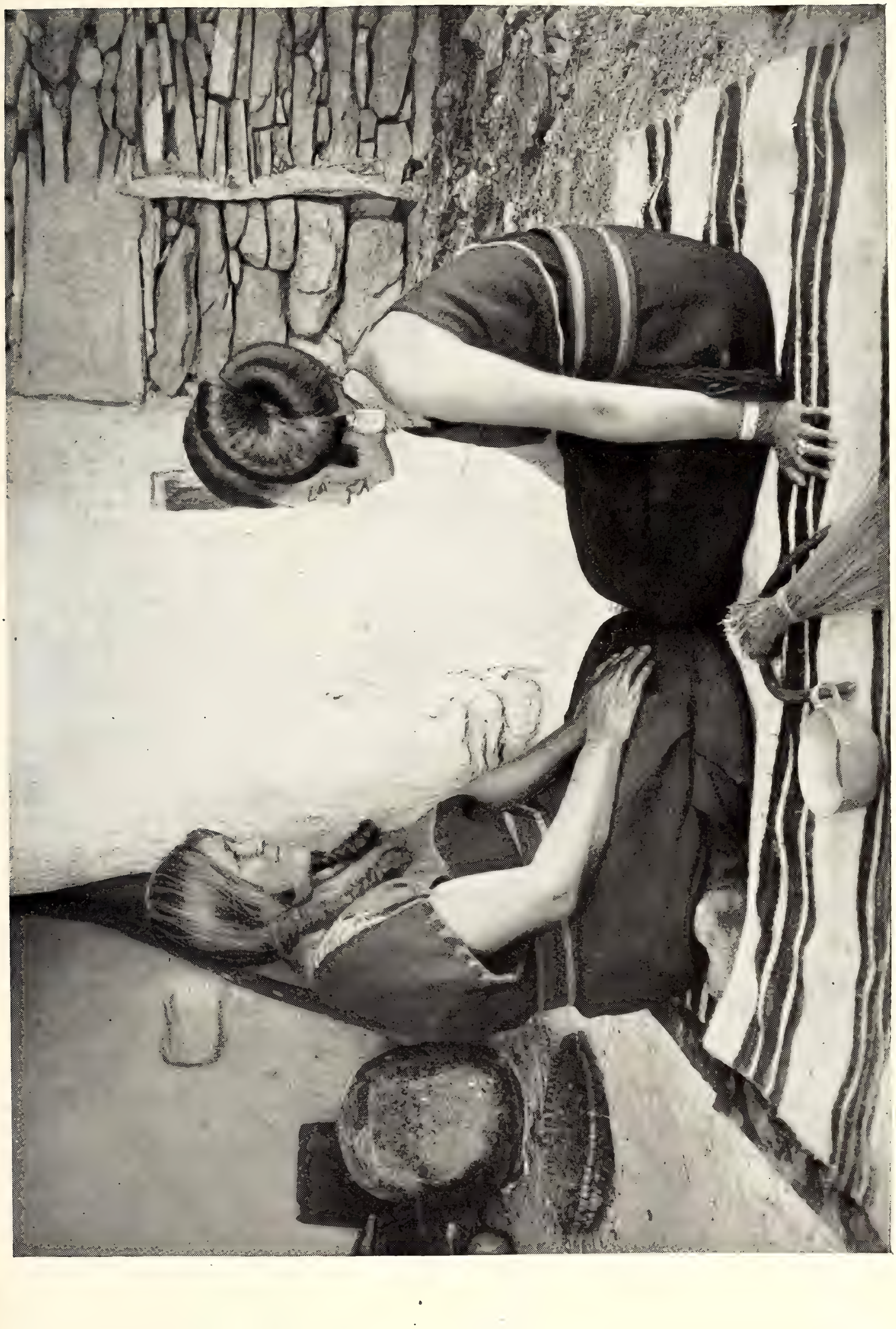


Photo by A. C. Vroman, of Pasadena, California

THE HAIR-DRESSING COMPLETED: GREAT WHEEL-LIKE COILS TO RESEMBLE THE SQUASH BLOSSOM

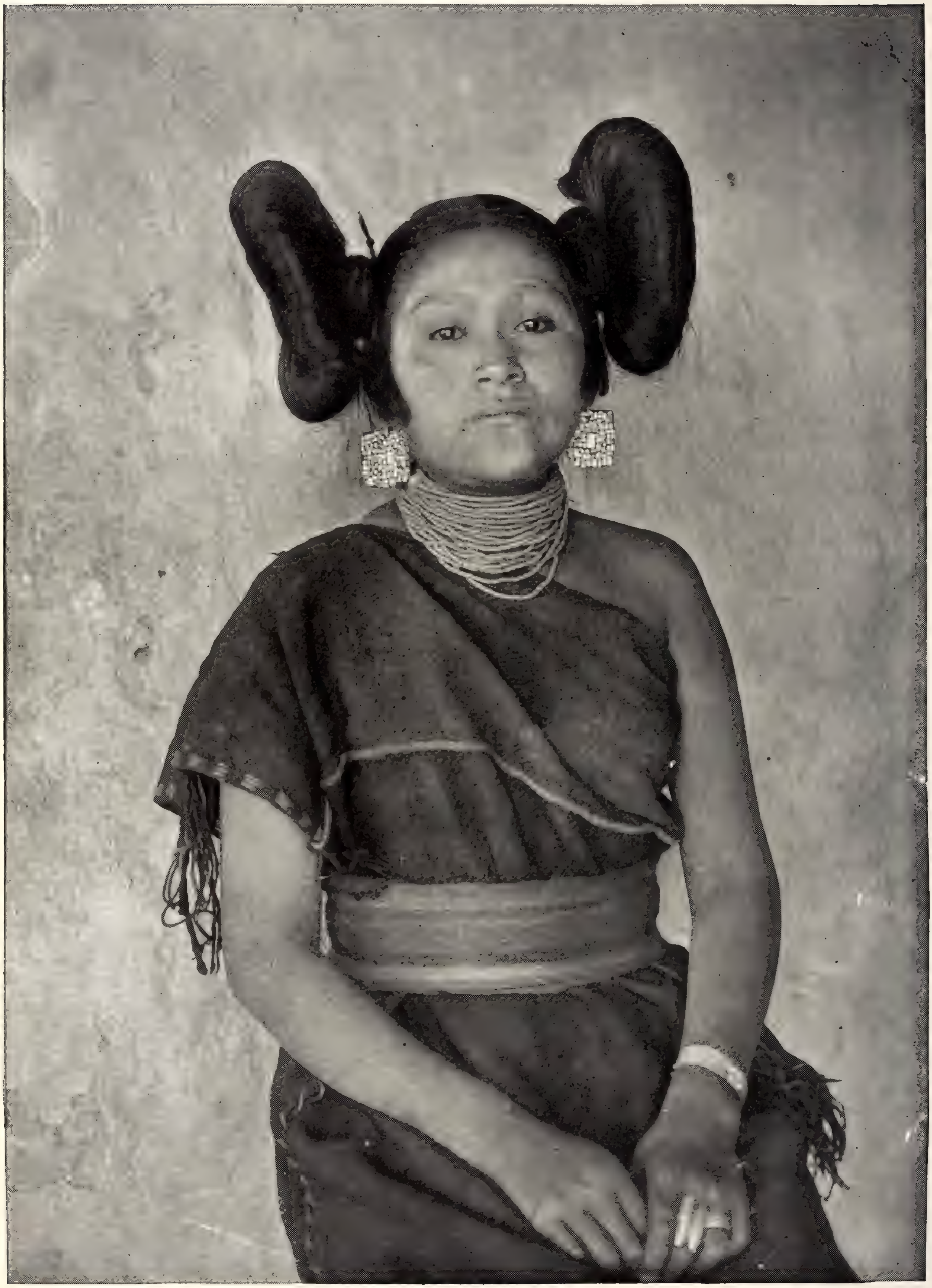


Photo by P. G. Gates, of Pasadena, California

A HOPI BELLE, DRESSED FOR THE SNAKE DANCE

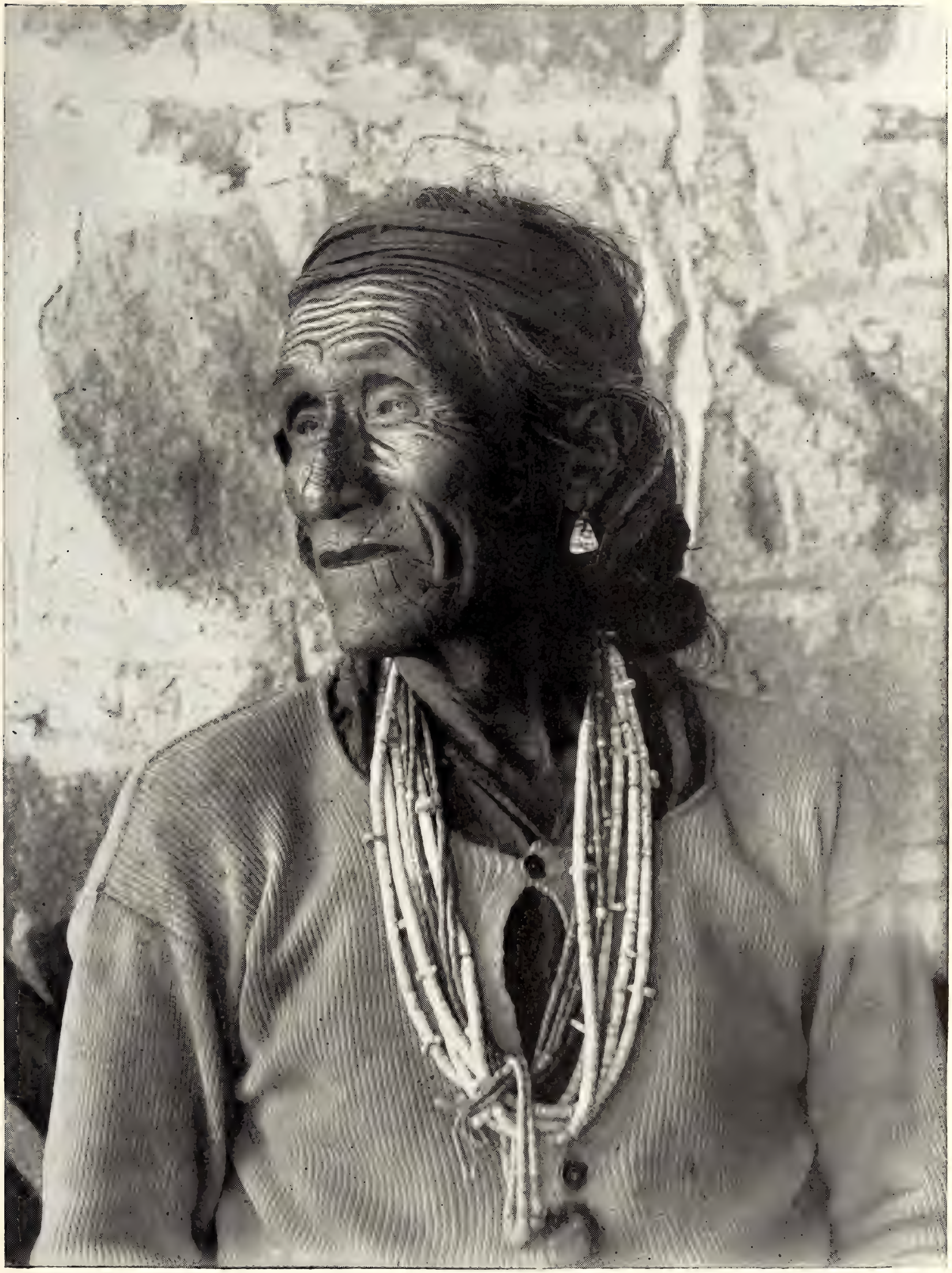


Photo by A. C. Vroman, of Pasadena, California

A HOPI CHIEF

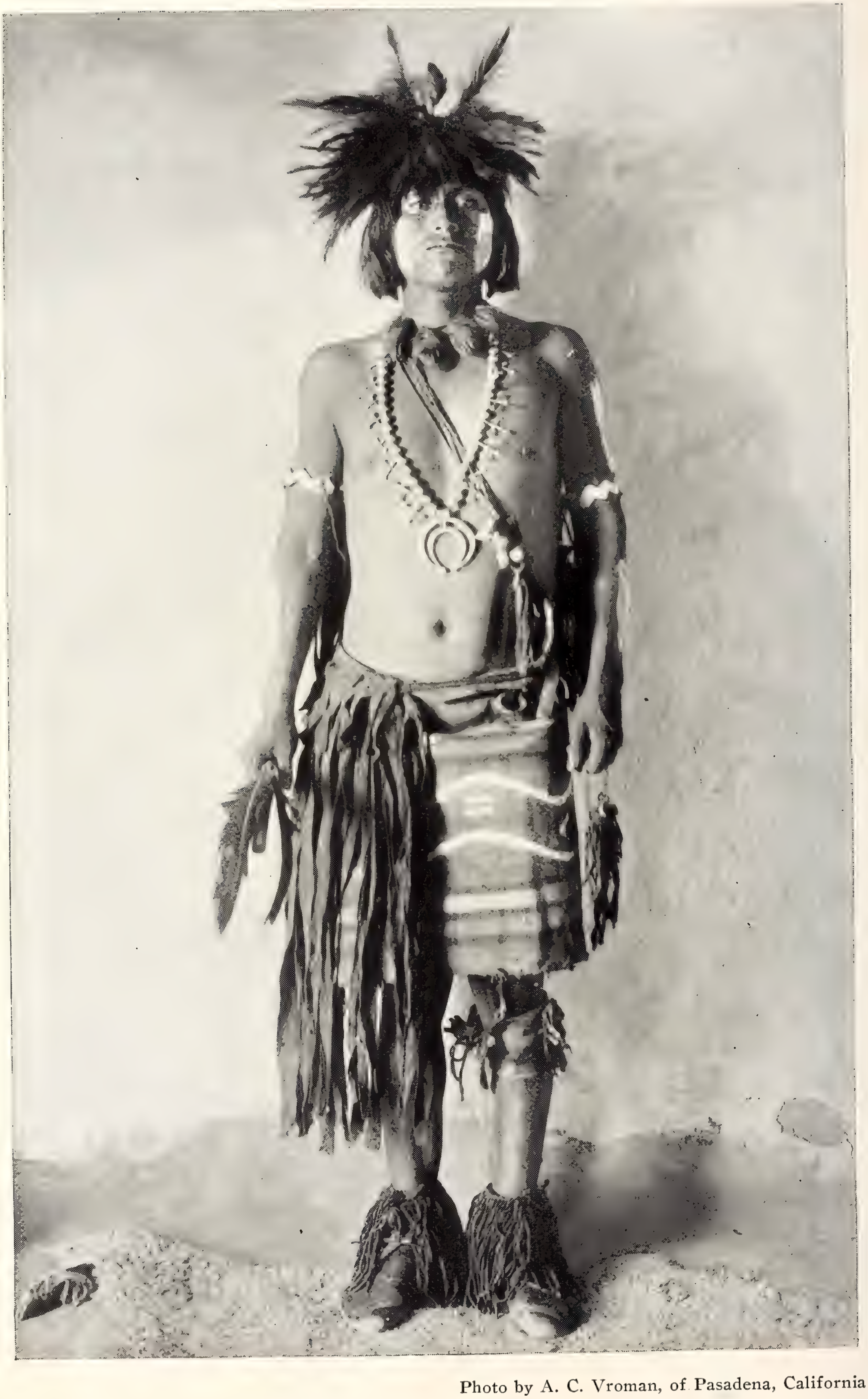


Photo by A. C. Vroman, of Pasadena, California

A SNAKE PRIEST DRESSED FOR THE DANCE

Note the crown of feathers on his head. With the feather in his right hand he charms the snakes

Woman's home she wove a deep basket, into which she packed Tigo and the two maidens, and then, letting down part of the web from the clouds and attaching it to the basket, the clouds drew them up safely to the upper world. Tigo gave the younger maiden to his brother and announced that in 16 days they would celebrate the marriage feast. On the fifth day after the announcement the Snake people from the underworld came to the upperworld, went to the kivas, and ate corn pollen for food. Then they left the kivas and disappeared.

"But Tigo and the maidens knew that they had only changed their appearance and were in the valley in the form of snakes. So he commanded his people to go into the valley and capture them, bring them to the kivas and wash them, and then dance with them. Four days were spent catching them from the four quarters; then with solemn ceremony they were washed, and while the prayers were offered the snakes listened to them, so that when at the close of the dance, where they danced with their human brothers, they were taken back to the valley and released; they were then able to return to the underworld and carry to the gods there the petitions that their human brothers had uttered on the earth."

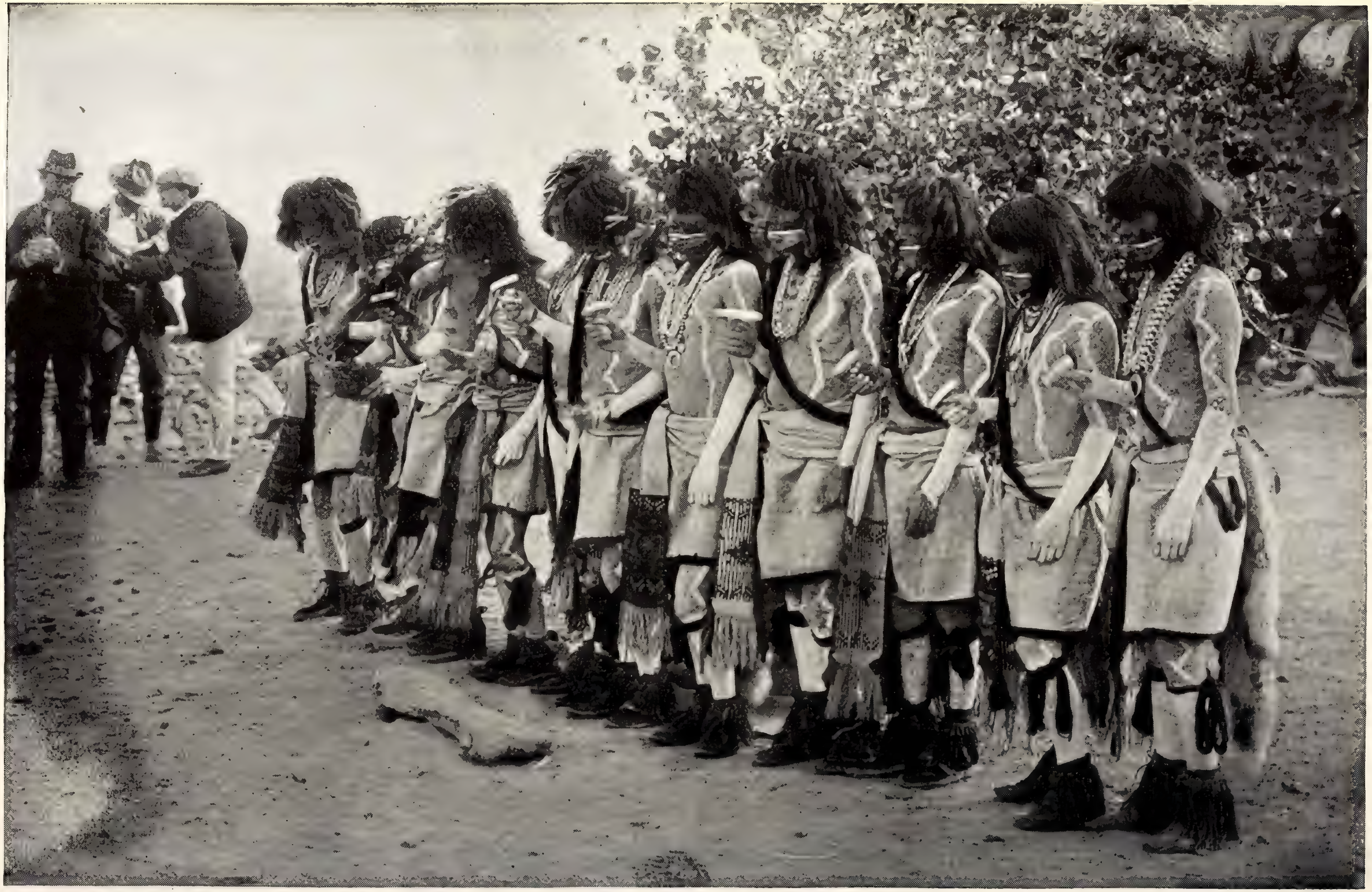
This was the origin and meaning of the unique ceremony we were to witness. I was so interested in the legend that before I knew it the sound of a whirring noise made me look up, and then I saw that the sun was setting and at last the time for the dance was come.

The whirring noise became louder and around the corner of the plaza appeared the priests of the Antelope clan, the harvest priests. They were naked to the waist, and were painted a warm red brown; from each shoulder and breast ran a white zigzag line to represent the lightning. They wore a kilt, which came to just above the knee; a gray fox skin hung behind, the tail almost touching the ground; necklaces of silver and beads were their ornaments. The chief Antelope priest had in his hand a weird wind instrument, which as he swung sounded like the angry, soughing wind of a storm. Many of the other priests carried rattles which made the sound of falling rain; others had ears of corn, or others harvest emblems.

Suddenly my companion caught my arm and said, "Look!" Following his pointing finger, I saw a priest ascending the ladder leading from the Snake kiva. He was covered with a long coat and carried a great bag, the contents of which writhed and wriggled. He came quickly into the plaza, deposited his bag of snakes under the tepee-like altar, and returned to the kiva.

I kept my eyes glued to the ladder, for I knew that the Snake priests had to come up that way, and I was rewarded, for just as the rays of the setting sun struck the top rung of the ladder a wild figure emerged, dressed more or less like the Antelope priests, but with long, flowing hair, crowned with masses of feathers. As he reached the top of the ladder he took a handful of sacred meal from his pouch, and with a splendid free gesture he flung it, with up and outstretched arm, towards the sinking sun and for a second stood like a bronze statue with arm uplifted as the meal, a tiny white cloud, floated downward over the edge of the mesa. Then he turned and stepped into the narrow street and another took his place, and another, and another, until all had left the kiva; then quietly and without any hurry they marched into the plaza and took their stand just opposite the altar, facing the Antelope priests. Then the chief priest of the village took some sacred meal and made a line with it between the Snake and Antelope priests.

Now the ceremony began. Crossing hands, they swayed from east to west with eyes half closed. After about 20 of these motions they burst into a deep-voiced chant, stamping with the left foot upon the ground. Next they swayed from west to east and again gave voice to the queer, low chant. I got a little nearer and heard that as they swayed they were praying in low tones.



THE ANTELOPE PRIESTS: ORAIBI Photo by A. C. Vroman, of Pasadena, California

"They were naked to the waist, and were painted a warm red brown; from each shoulder and breast ran a white zigzag line to represent the lightning. They wore a kilt, which came to just above the knee; a gray fox skin hung behind, the tail almost touching the ground; necklaces of silver and beads were their ornaments." They hold rattles in their hands (see page 125).

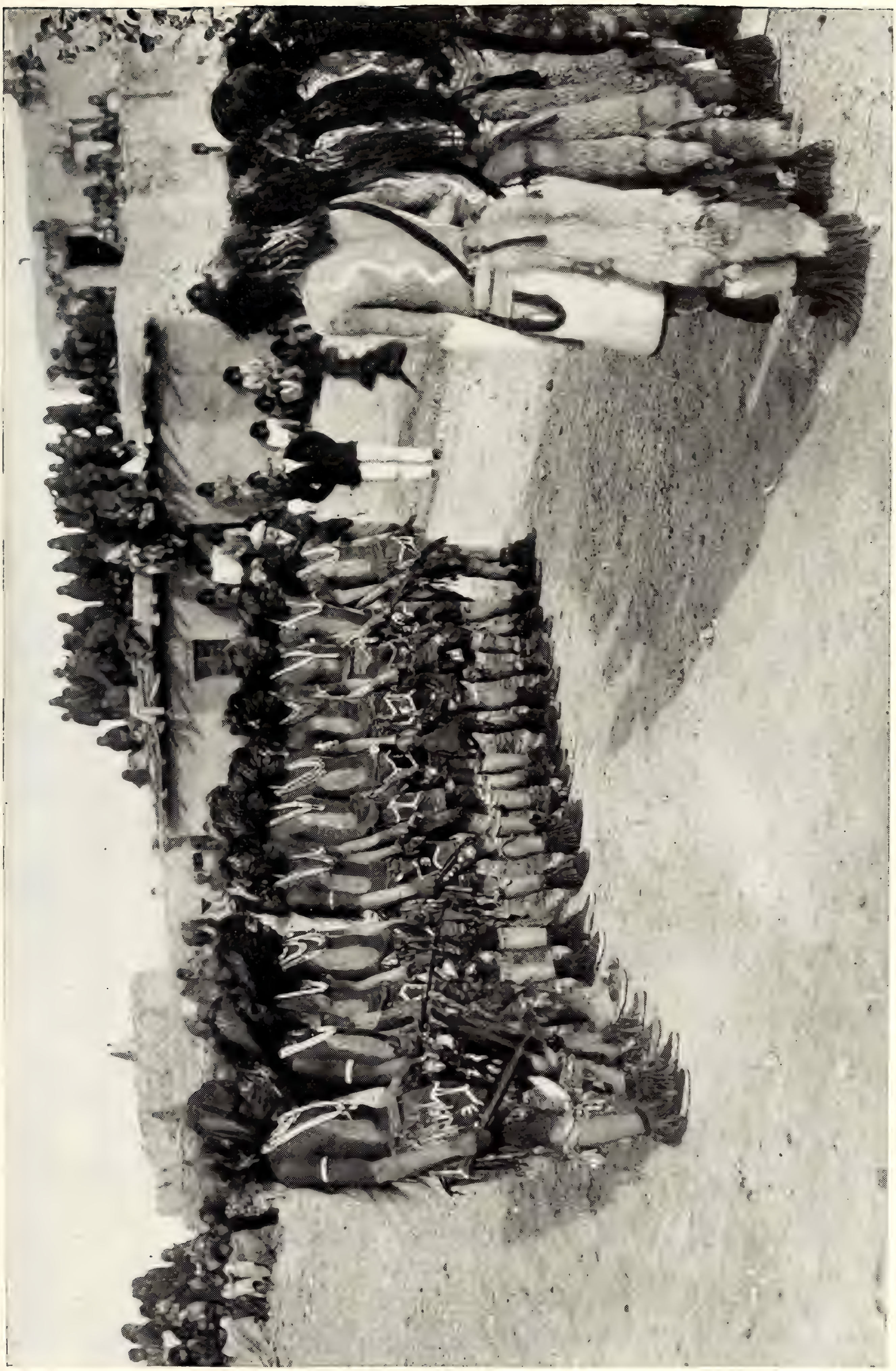
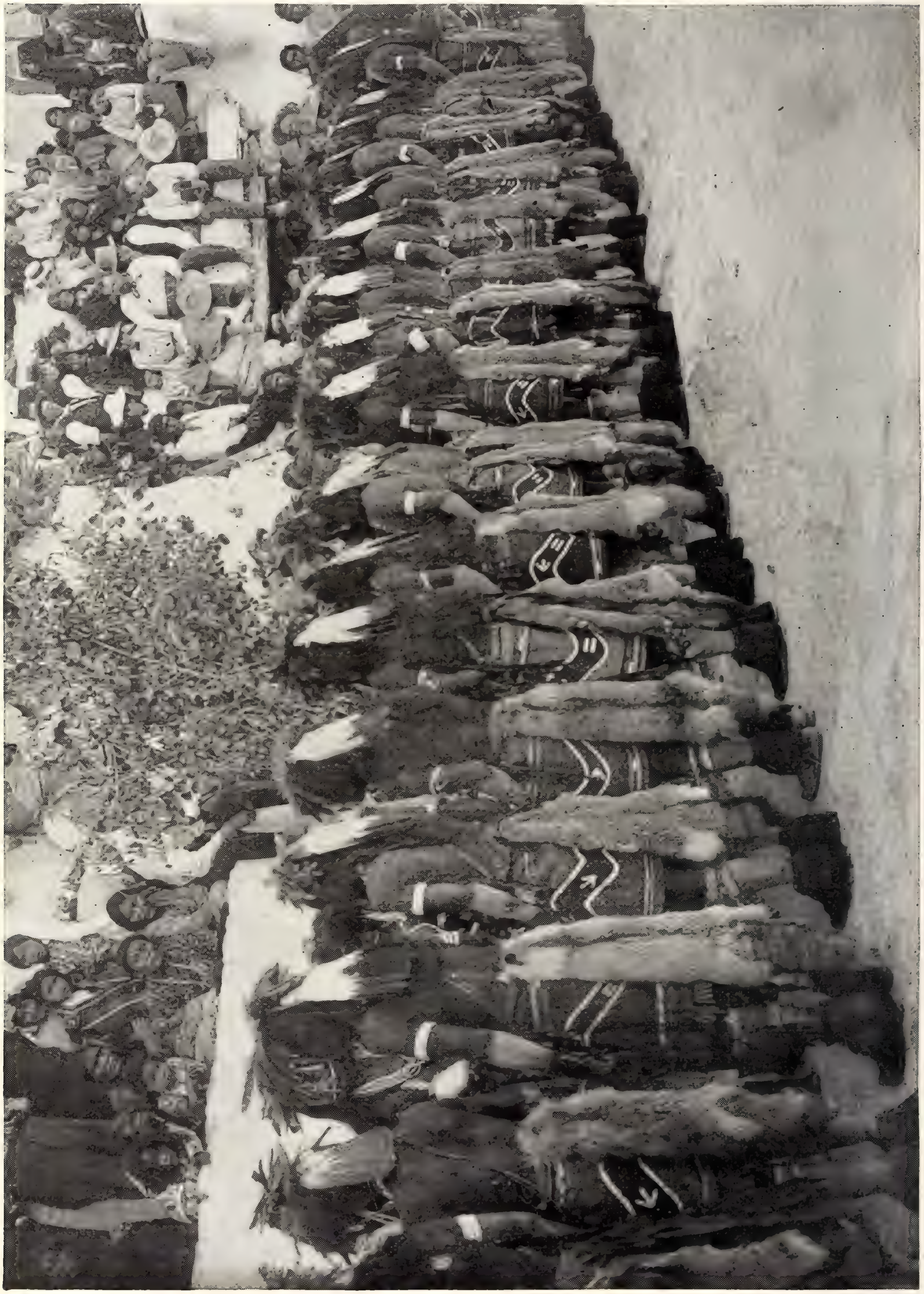


Photo by A. C. Vroman, of Pasadena, California

THE SNAKE PRIESTS TOOK THEIR STAND JUST OPPOSITE THE ALTAR FACING THE ANTELOPE PRIESTS (SEE PAGE 125)



THE SNAKE PRIESTS IN LINE BEFORE THE ALTAR Photo by A. C. Vroman, of Pasadena, California

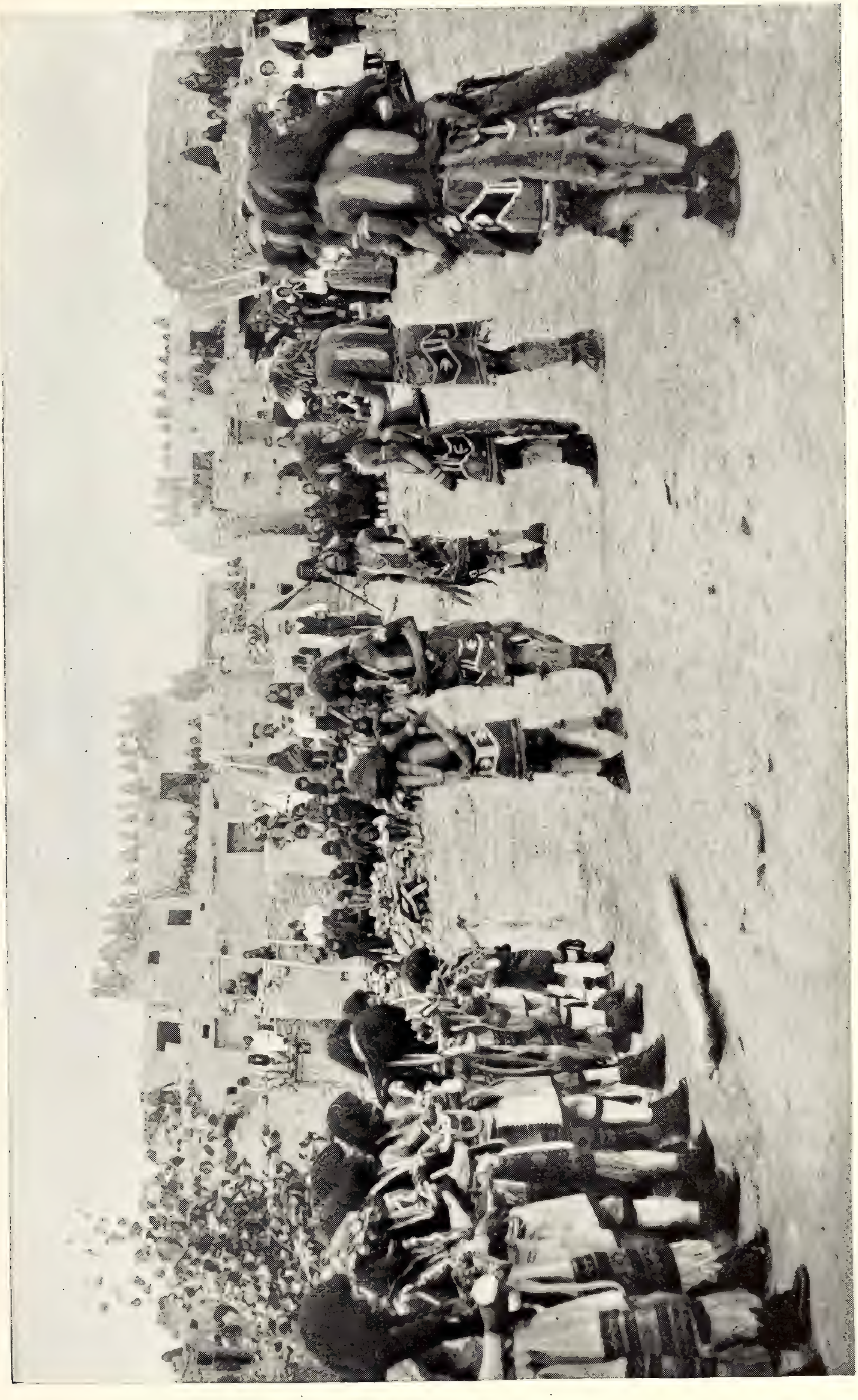


Photo by A. C. Vroman, of Pasadena, California

“As they passed the altar they paused and stamped twice on a board that was over a hole in the ground . . . to awaken the spirits of the underworld to hear their prayers” (see page 131)

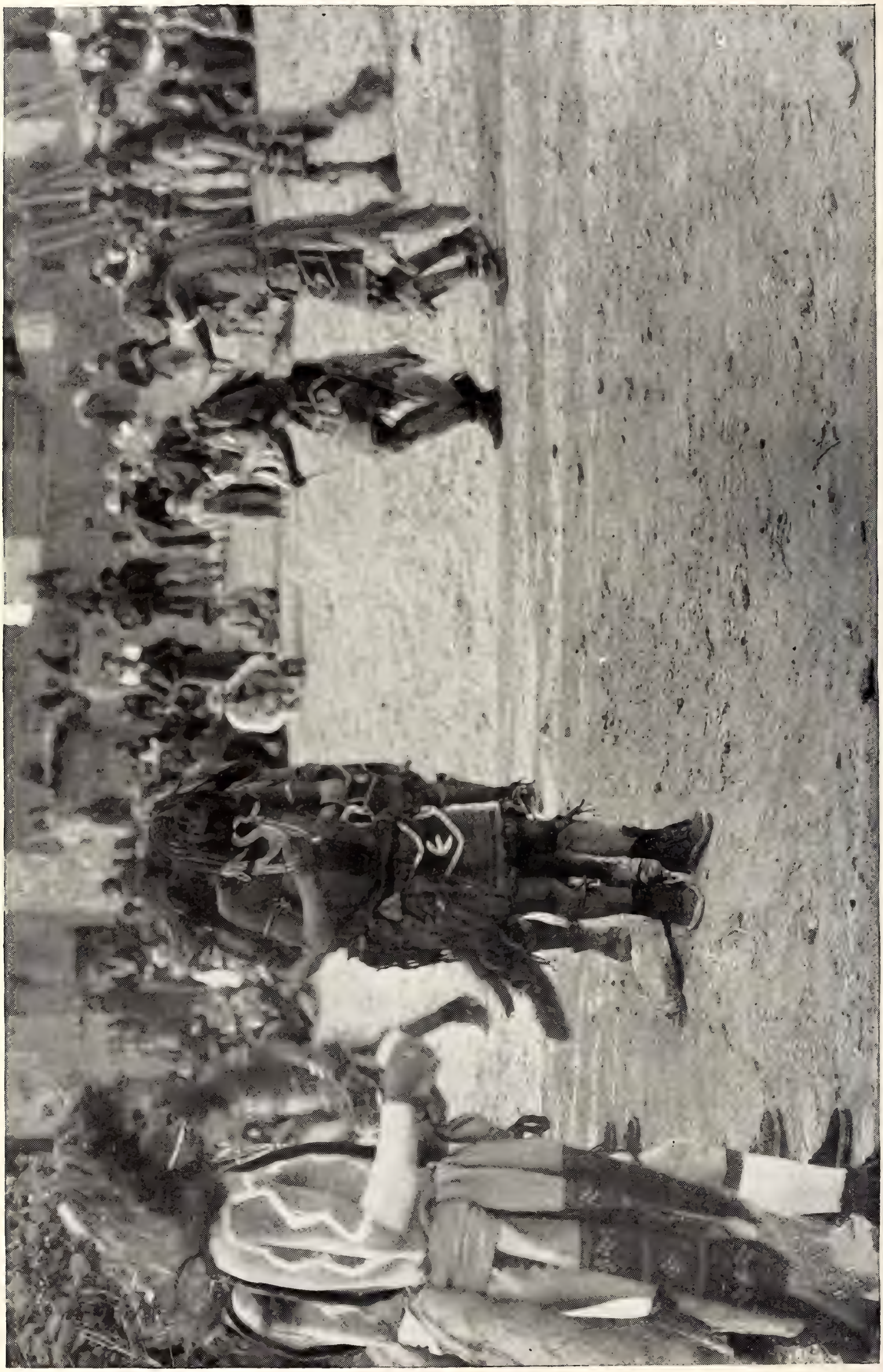


Photo by A. C. Vroman, of Pasadena, California

"EVERY OTHER MAN HAD A SQUIRMING LIVE RATTLESNAKE IN HIS MOUTH" (SEE PAGE 131)

After a while some of the priests began to look half hypnotized, and sang with their eyes fixed and heads bent. The silence, except for the chanting, was getting on my nerves. I looked around and saw crowds of people, all silent; even our troopers were quiet. Suddenly the singing stopped and the Snake priests stood in line, single file, only every other priest had his hand on the shoulder of the one in front of him and in the other hand carried a wand of eagle feathers. Four other Snake priests stationed themselves at the four points of the compass.

Then suddenly the "Antelope Clan" began another chant, louder and far wilder than before. They stood in front of the altar, swaying forwards and backwards. At about the second stanza the Snake priests began to move; around they went, around the plaza, with a funny, high-stepping motion. As they passed the altar they paused and stamped twice on a board that was over a hole in the ground.

I asked my companion what it meant, and he said that the Hopis believe that that hole leads to the underworld and they are awakening the spirits to hear their prayers.

The second time the priests passed the altar I saw them pause, but only when they had turned facing me I realized the horror. Every other man had a squirming live rattlesnake in his mouth! The snakes were curling themselves into all kinds of horrible shapes, and their evil heads went darting this way and that.

I saw one rattler strike a man just under the ear. He had to pull it loose, but took a fresh hold of the snake nearer its head and seemed none the worse for it.

Now I saw the reason for the second priests with the feather wands. Their duty was to soothe the snake by stroking it with the feathers, and to guide the snake-carrying priest, who often looked as if he was in a trance. Once around the plaza they would dance with their ghastly burden, and then, putting it down facing one of the four points of the compass, they would leave it, going on to the altar for a fresh one.

As soon as the snake was released, off it would glide, trying to get to the refuge of one of the houses, or into the crowd which surrounded the plaza like a living wall; but, before it could reach either, the priest stationed at that point would come behind it and stroke it with a feathered wand similar to those of the guiding priests. The snake would hiss and try to coil and strike, but the tickling of the feathers would make it un-

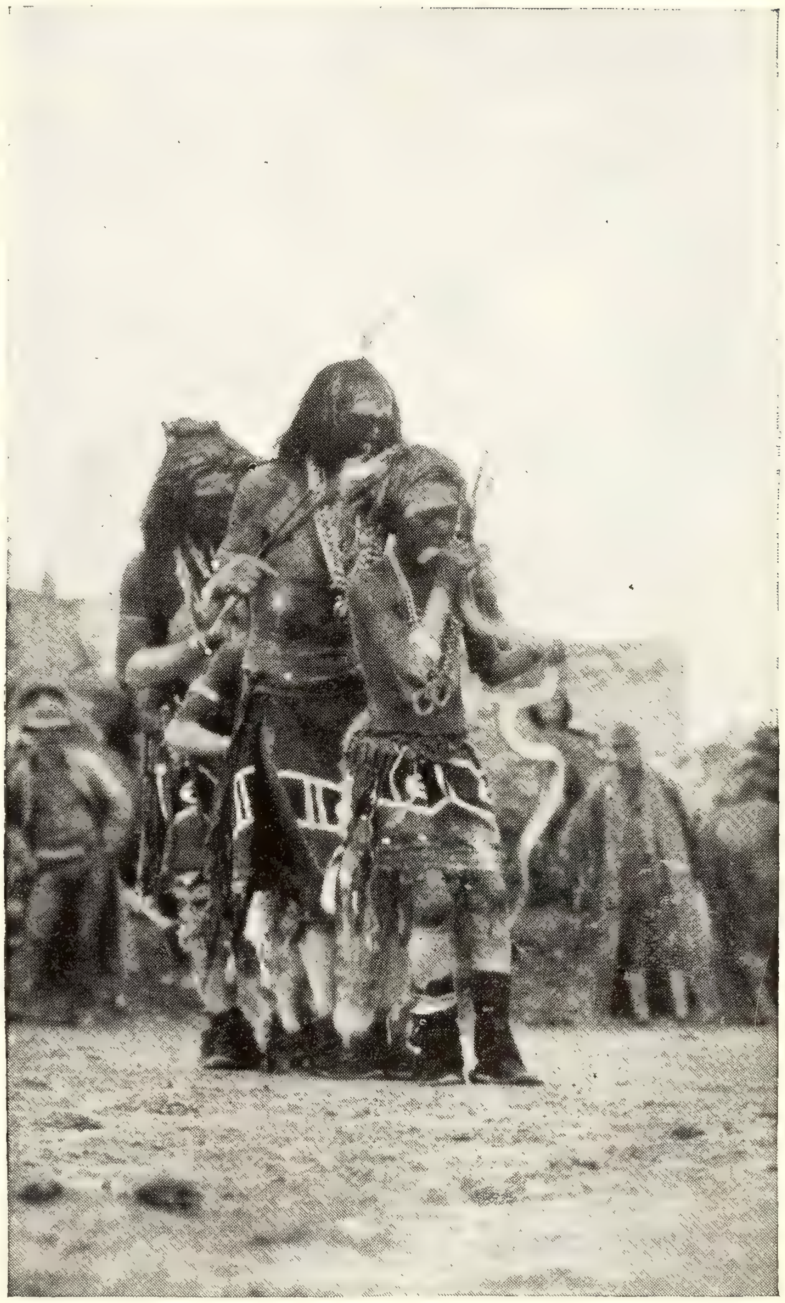


Photo by Mrs. Herbert Wadsworth

"I saw one dancing with a bull snake bigger than himself, and the little boy had to hold it with both hands, as well as with his teeth, to prevent it from getting away (see page 133).

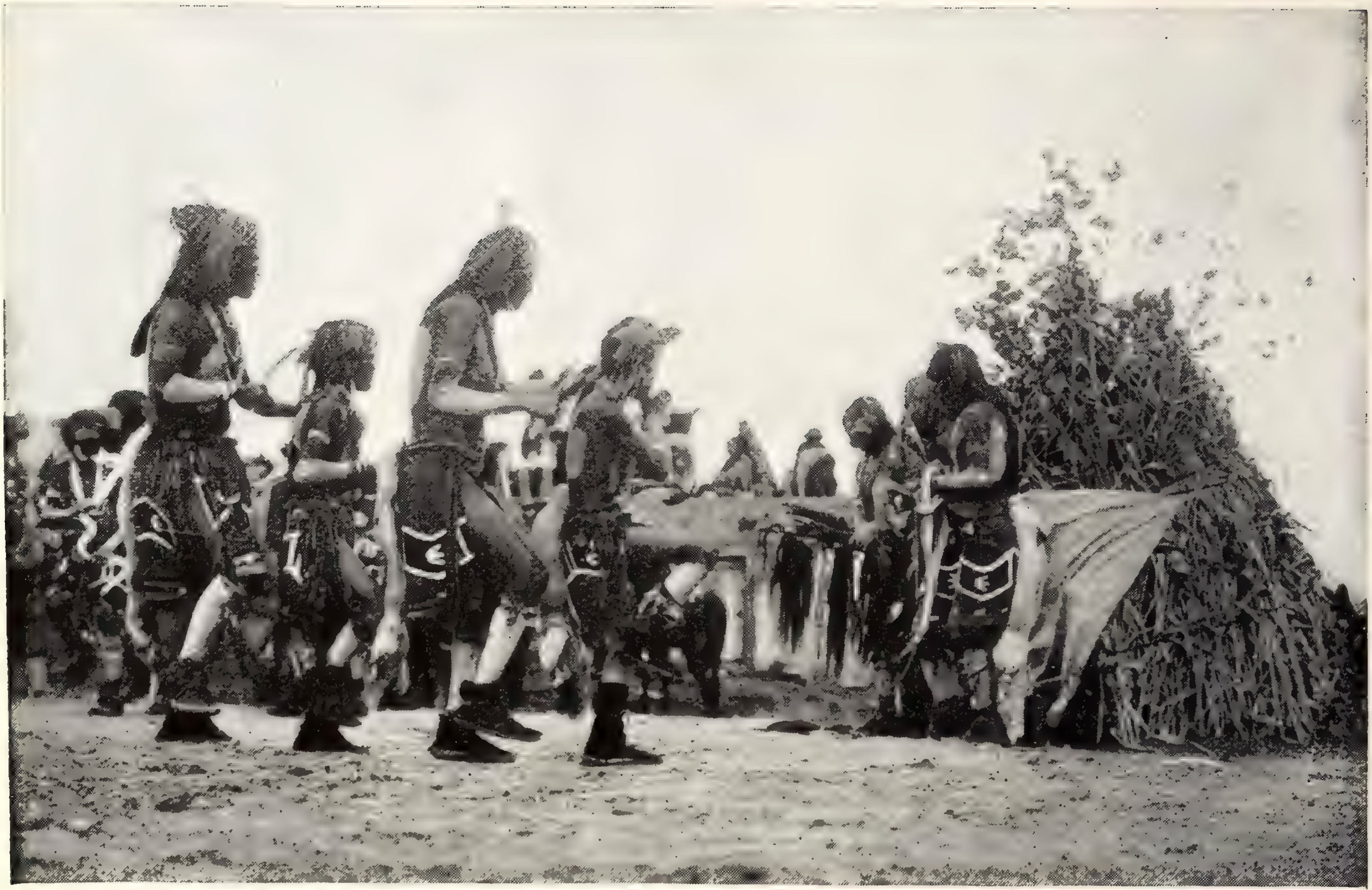


Photo by Mrs. Herbert Wadsworth

"Every other priest had his hand on the shoulder of the one in front of him, and in the other hand carried a wand of eagle feathers. Their duty was to sooth the snake by stroking it with feathers, and to guide the snake-carrying priest who often looked as if he was in a trance." The tepee-like altar and the great bag which contained the snakes are clearly shown in the picture.

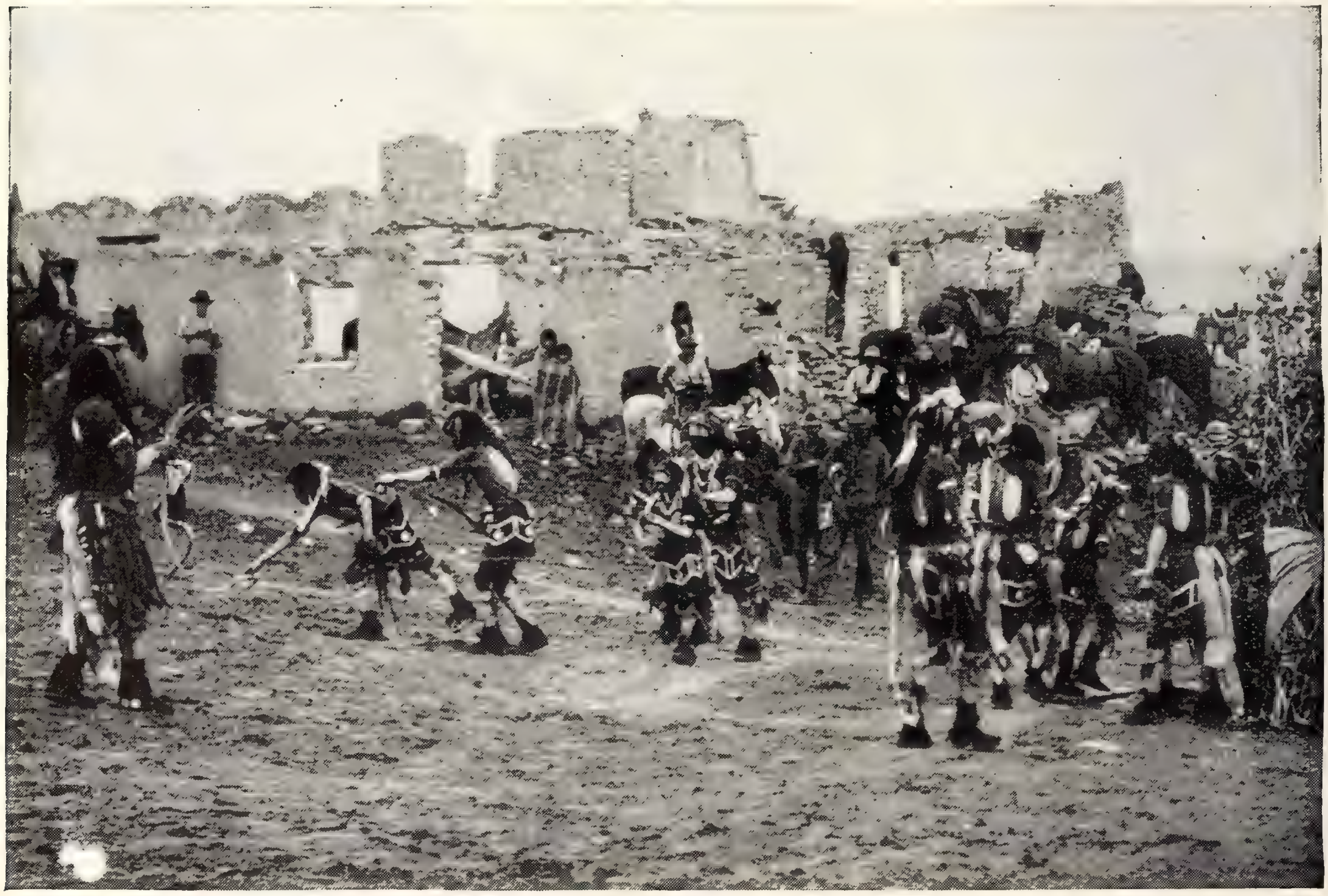


Photo by Mrs. Herbert Wadsworth

After dancing once around the plaza, the priest places the snake on the ground and goes to the altar for a fresh one (see page 131) coil; then, with a long swing of the arm, the priest would pick it up with about as much unconcern as most people would pick up a rope.

Two of the Snake priests were little boys who were serving their novitiate, and who could not have been more than eight years old. I saw one of them dancing with a bull snake bigger than himself, and the little boy had to hold it with both hands as well as with his teeth to prevent it from getting away.

The chanting became louder and louder, and on and on went the priests until every snake had been danced with.

A group of Hopi maidens now entered the plaza. Their hair was done in the great wheel-like coils on either side of their heads, to resemble the squash blossom, and they were dressed in their very brightest and best and carried ceremonial baskets filled with sacred meal. As they neared the altar the priests rushed forward and threw all the snakes on the ground in a great squirming mass at their feet, and the maidens sprinkled the hideous reptiles with the meal.

Then, at a signal from the chief priest, the Snake priests bent down and each seized two handfuls of snakes, and turning ran with incredible swiftness out of the plaza, some to the north, some south, some east and west. We watched and saw them rush over the mesa and down its almost perpendicular sides until they reached the desert. There with a parting message to their spirit brothers they left them at the four points of the compass to go whither they would.

Then, mounting the mesa once more, the priests halted where some hollowed-out rocks had formed basins and had caught the rain-water. There they stripped and washed off the ceremonial paint. Then, to my dismay, they drank something that proved to be a strong emetic, and for a few minutes I found

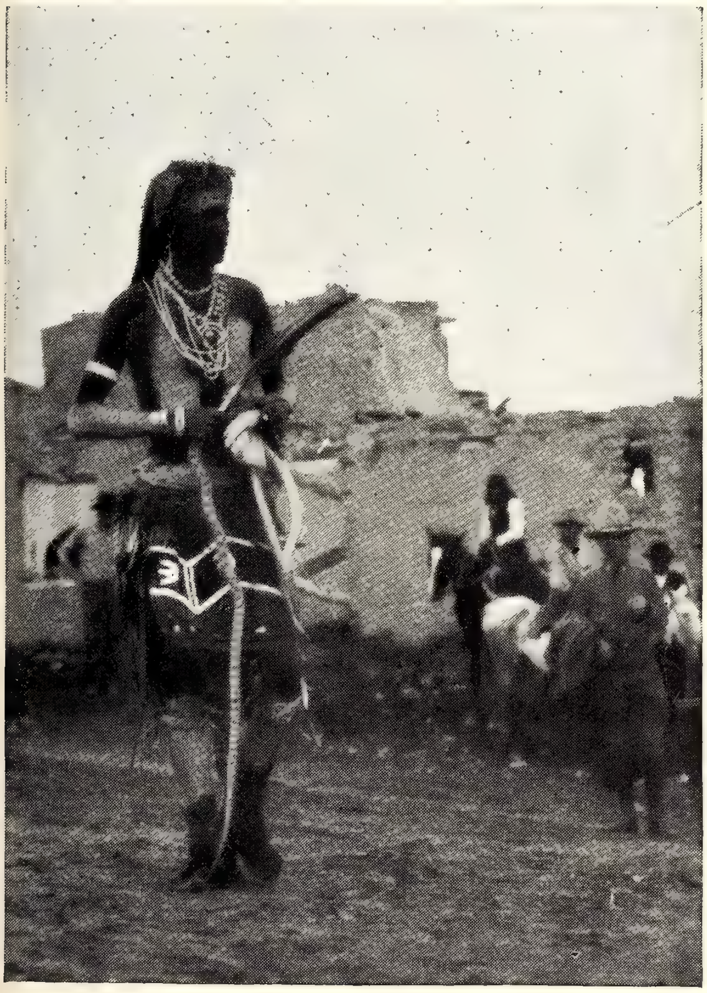


Photo by Mrs. Herbert Wadsworth

A SNAKE PRIEST, ORAIBI: NOTE THE LONG SNAKE HELD IN THE LEFT HAND

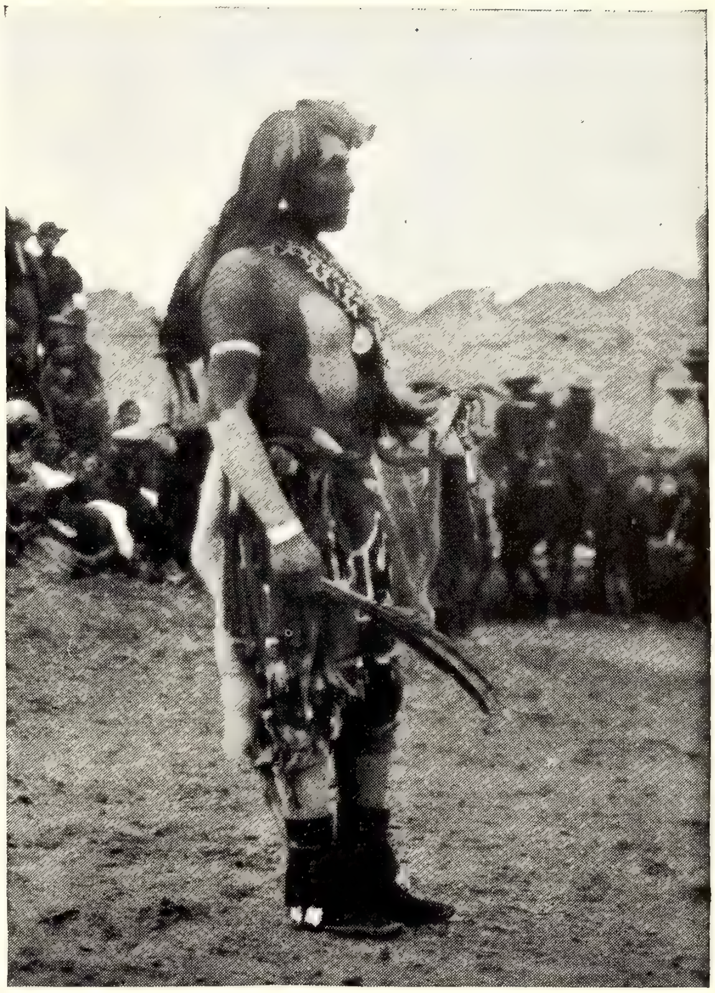


Photo by Mrs. Herbert Wadsworth

One of the four snake priests who was stationed to gather up the snakes that had been danced with (see page 131).

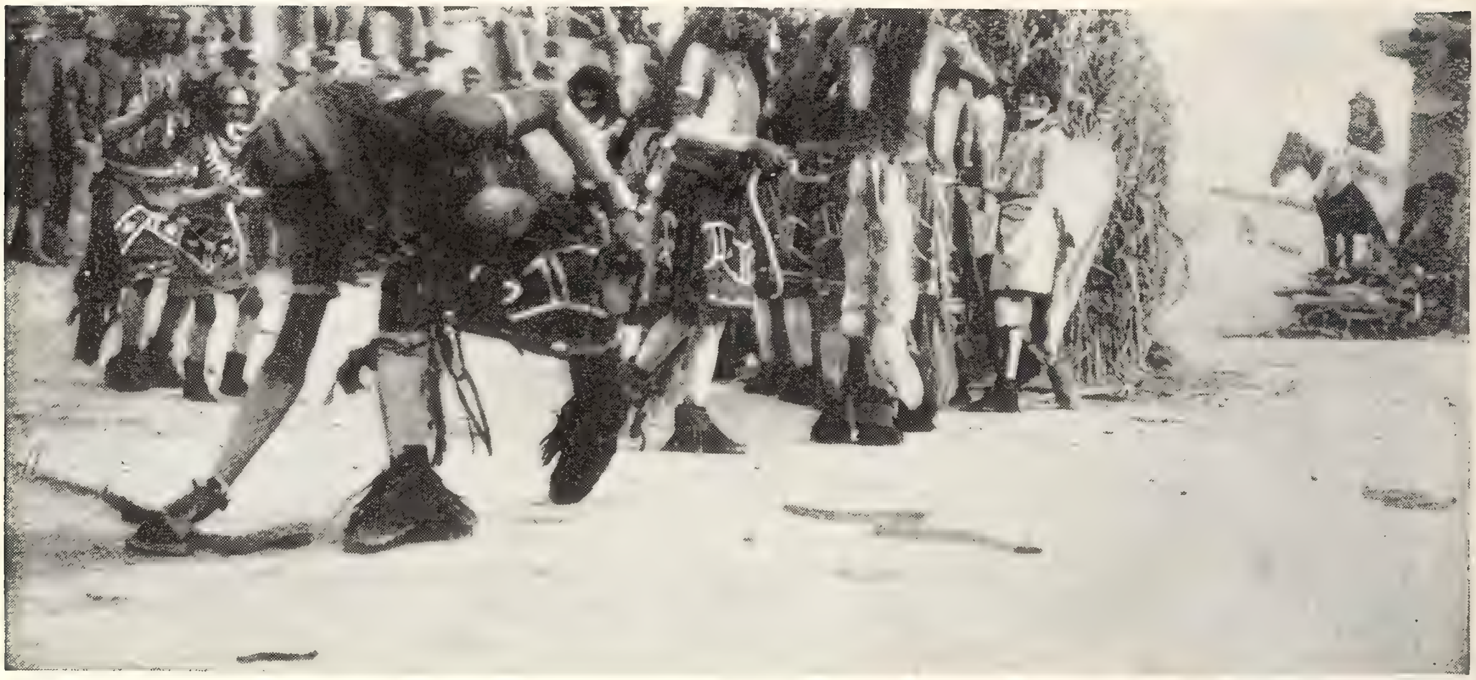


Photo by Mrs. Herbert Wadsworth

A SNAKE PRIEST TICKLING A SNAKE WITH FEATHERS TO MAKE IT UNCOIL (SEE PAGE 131)

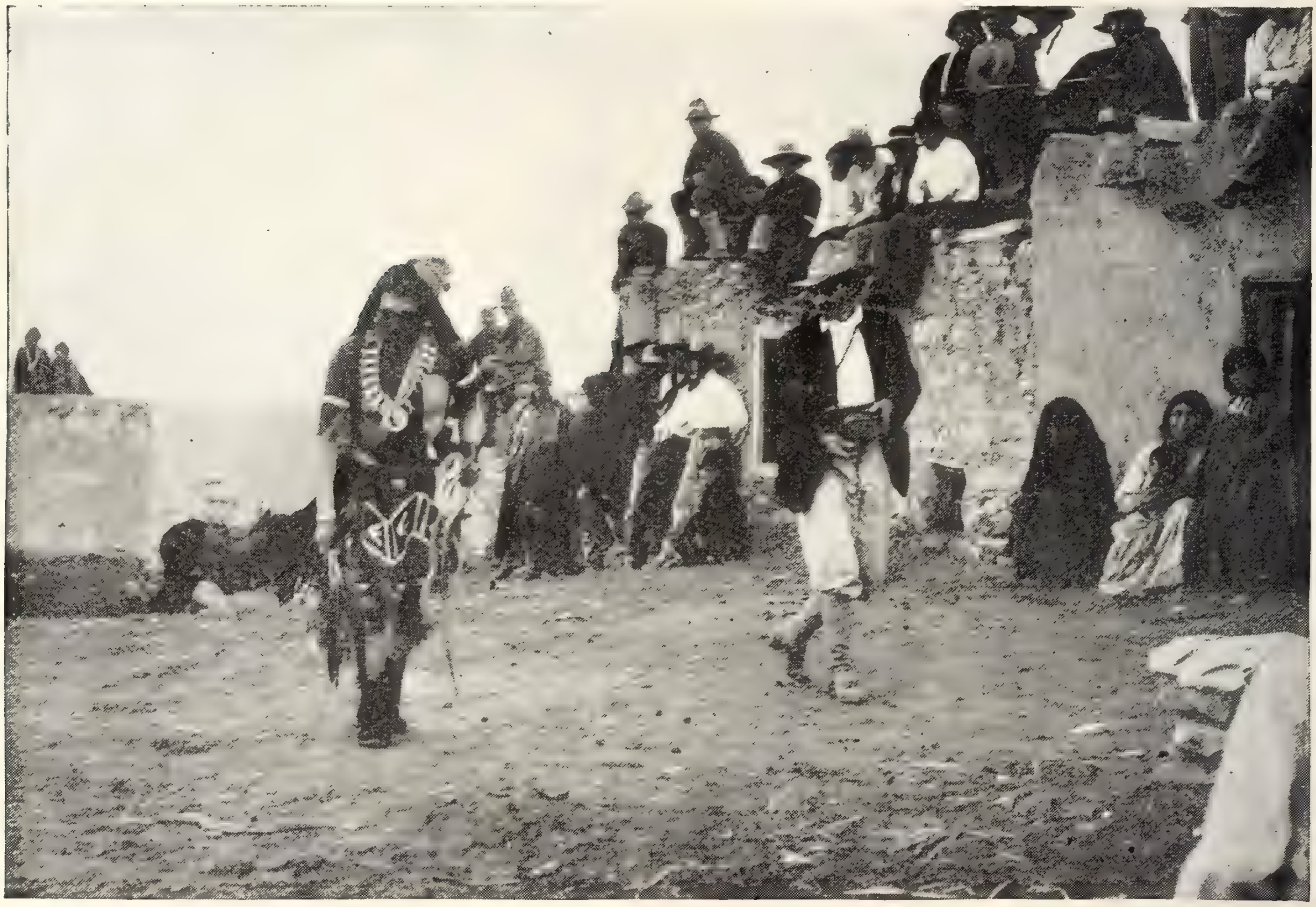


Photo by Mrs. Herbert Wadsworth

The priest holds two rattlesnakes in his left hand. With the feathers held in his right hand he has been stroking the snake on the ground, thus making it uncoil, and he is now about to seize it (see page 131). Oraibi.

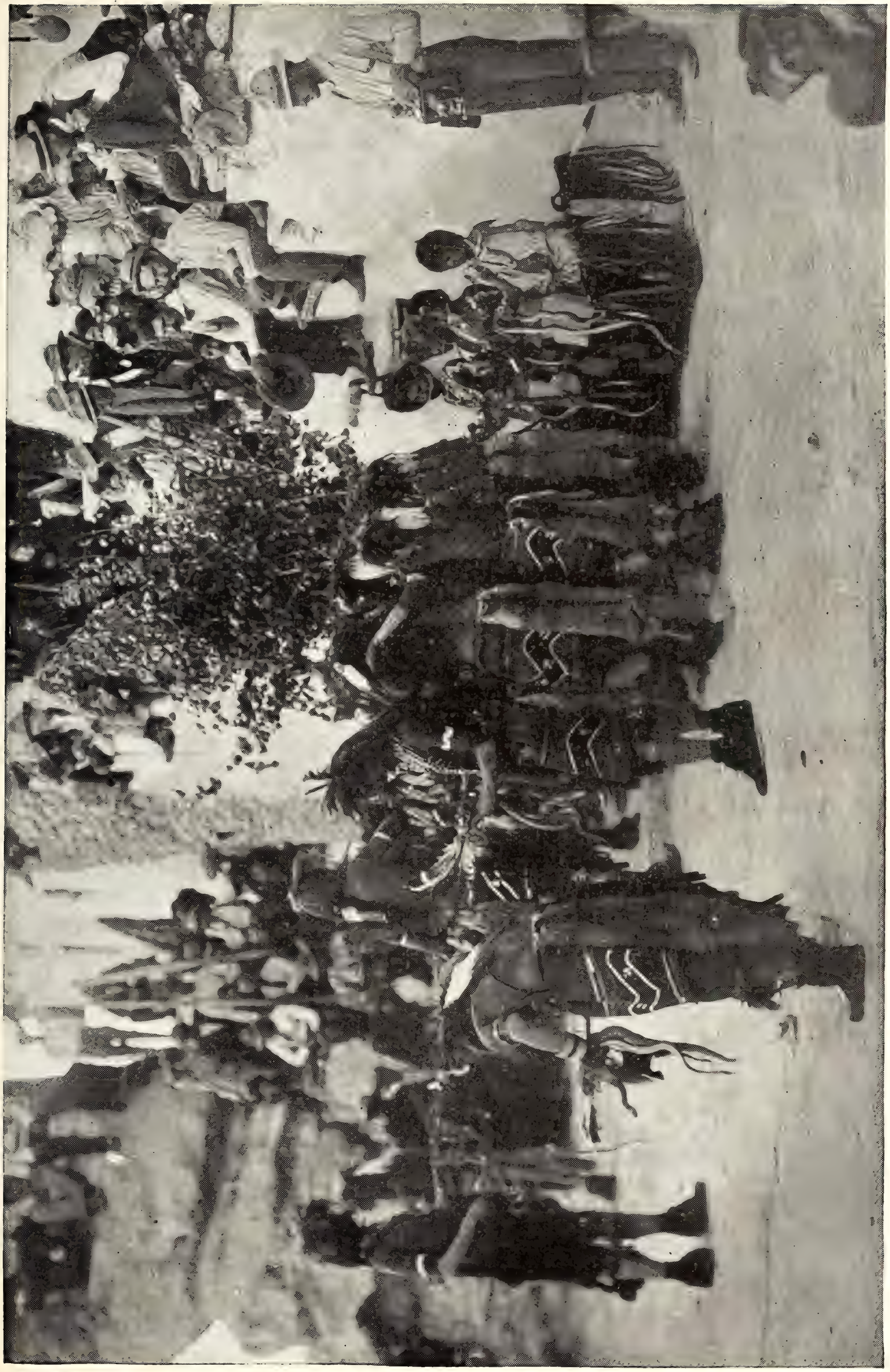


Photo by A. C. Vroman, of Pasadena, California

THE END OF THE SNAKE DANCE: WAITING FOR THE HOPI MAIDENS TO BRING THE SACRED MEAL

The stooping figure in the left foreground is about to recover the snake on the ground by first tickling it so that it will uncoil

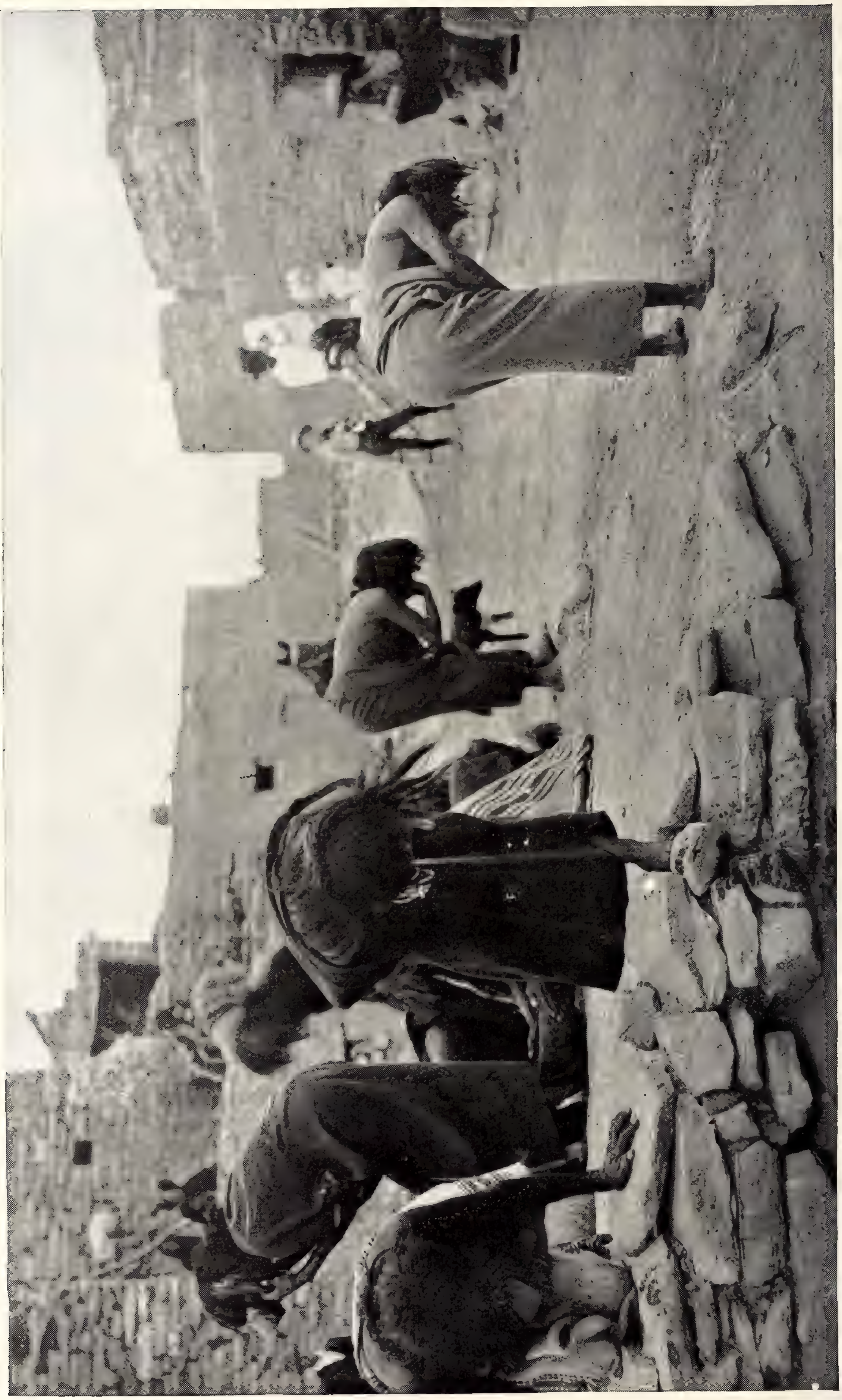


Photo by A. C. Vroman, of Pasadena, California

THE PURIFICATION AFTER THE DANCE WITH THE SNAKES (SEE PAGE 137) it best to look away and think of more pleasant things. At last their purification was over and on they came. Running very swiftly, they passed us like a brown flash, and then, with a last farewell gesture to the now almost-vanished sun, their kiva swallowed them up and I realized the dance was over.

I rode back to camp very silent, the whole thing leaving me rather dazed, it seemed so weird, so unreal; and yet the knowledge that the dance was the culmination of 16 days of fasting and prayer, and the intense religious attitude of both priests and people, impressed me more than I was willing to admit.

How was it that the poison of the snakes had no effect on the dancers? I asked many for the solution of this problem, and their answers were always the same, "We don't know; all we know is, if any trader or sheep-herder is bitten by a rattler, if we can get them to the Snake priests they are always saved. The cure, whether drug, herb, or incantation, is kept secret, and the Snake clan guard it as a sacred trust, never to be divulged under any conditions."

It was with real regret we broke camp next day, and, as we rode across the desert, for several hours I kept looking back at the mesa and the little Hopi town, clothed in a dignity of its own, holding the faith of its forefathers unchanged, unmoved by the centuries of civilization.

TAMING THE WILD BLUEBERRY

By Frederick V. Coville

As the result of Mr. Coville's experiments with blueberries, it is very probable that in a few years blueberries will be cultivated in the United States as extensively and profitably as the cranberry. All the blueberries now used are picked wild, just as were all the cranberries not so very many years ago. Many persons in many parts of the United States now make good incomes by cultivating the cranberry. Last year, for instance, the cranberry crop amounted to about one million and a half bushels, worth three million dollars. Readers of this Magazine desiring further information on the cultivation of blueberries are referred to "Experiments in Blueberry Culture," by Frederick V. Coville, recently published by the United States Department of Agriculture as Bulletin No. 193 of the Bureau of Plant Industry.

THE "taming of the wild blueberry" has involved the pursuit of a strange and often dim trail of scientific search, in the following of which a curious chapter has been added to the ever-increasing Book of Marvels in which our knowledge of the foundations of agriculture is recorded.

The name blueberry is applied in New England to plants of the genus *Vaccinium,* which have seeds so small as to be unnoticeable when the berry is eaten, while the name huckleberry is usually restricted by New Englanders to the genus *Gaylussacia,* in which each seed is surrounded by a bony covering like a minute peach pit, which crackles between the teeth.

In the South and West, however, the name huckleberry is applied with little discrimination to the various wild species of both *Vaccinium* and *Gaylussacia,* about 40 in number. This article deals principally with the swamp or highbush blueberry, *Vaccinium corybosum,* which commonly grows from 4 to 7 feet high, and produces berries in abundance and of especially good flavor.

The wild blueberries are everywhere utilized for pies and jam and the well-beloved blueberry cake and blueberry pudding. An accurate valuation of the wild blueberry crop has never been made, but it undoubtedly reaches millions of dollars annually. In blueberry districts the yearly shipments from single small

A CLUSTER OF BLUEBERRY BLOSSOMS (NATURAL SIZE)

towns often bring ten, or twenty, or even thirty thousand dollars, and in Northern cities, as for example Boston, New York, Detroit, and Chicago, the annual consumption is enormous.

Many attempts have been made to cultivate the blueberry for its fruit; but, when given the care, protection, and nourishment that man has found necessary for the ordinary plants of agriculture, the blueberry sickens and dies. The belief is prevalent among farmers that it is impossible to transplant the wild blueberry successfully. And it really is impossible if, as usually happens, the planting is done in the soil of a fertile garden.

What the blueberry demands is acidity. In a soil so acid that ordinary plants die of poison and starvation, the blueberry thrives, luxuriating in flower and foliage and fruit. That a plant should grow better in an acid soil than in a fertile one is contrary to what has been regarded as one of the fundamental principles of agriculture.

Ordinary agricultural plants absorb their nitrogen from the soil in the form of nitrates. From the cumulative researches of a group of scientists who have exhaustively studied the question for a generation, it has been established that the production of nitrates in the soil is brought about by certain microorganisms known as nitrifying bacteria; and, furthermore, that the ability of these bacteria to manufacture nitrates is destroyed by acidity. Growing as it does in an acid soil, the blueberry is therefore squarely up against the question how it shall get its nitrogen. To the individuals of the plant world the nitrogen problem brings about the same tragic situations as does the bread problem to the human race.

PLANTS THAT TRAP INSECTS FOR FOOD

One group of acid-soil denizens, the insectivorous plants, has solved the nitrogen question in a singularly direct way. They entrap insects and digest and absorb their nutritive parts. Of such habits among our native plants are the sundews (*Drosera*), the pitcher plants (*Sarracenia*), the bladderworts (*Utricularia*), the butterworts (*Pinguicula*), and the Venus' flytrap (*Dionaea*).

Another method of getting nitrogen in acid soils is represented by the European lupin. These plants have on their roots living tubercles within which grow certain bacteria. It has been found to be the function of these bacteria to take the nitrogen of the atmosphere and convert it into some chemical combination in which the lupin plant can use it. The very similar tubercle bacteria of the roots of clover and other cultivated leguminous plants have been much studied in the last 30 years, and the fact of the fixation of atmospheric nitrogen by them has been fully established and is everywhere recognized in agricultural practice. The blueberry gets its nitrogen by

A THREE-YEAR-OLD BLUEBERRY PLANT IN BLOOM

neither insect trap nor root bacteria. The microscopical examination of the plant, however, disclosed the presence of a fungus growing partly outside and partly inside the epidermal cells of the root. The fungus is exceedingly minute, the threads of which it is composed having a diameter of 0.00006 to 0.00012 of an inch. The fungus occurs in great abundance on the roots of vigorous plants. The cells in which it is found are not swollen nor distorted, nor do their contents collapse or show any of the other effects usually produced by injurious fungi. There is no indication that the fungus is in any way obnoxious to the plant. On the contrary, the uniformity with which it has been found to occur on healthy plants and its frequent absence or scarcity on sickly plants are at once suggestive of a mutually beneficial relationship.

It is well known that fungi differ from the higher plants in being able to take their required nitrogen directly from organic nitrogen compounds. They do not require that the nitrogen they consume shall be in the form of nitrates. Fungi are particularly abundant in the decaying vegetable matter forming the leaf litter of a forest, though this litter may be distinctly acid in its chemical reaction. Indeed, they grow luxuriantly on vegetable remains containing no nitrates and of such acidity that the conversion of humus nitrogen into nitrates by means of bacteria cannot take place.

As a reasonable explanation of the phenomena presented in the peculiar life history of the blueberry, the conclusion has been reached that the root fungus extracts nitrogenous food from the non-nitrified acid organic matter with which it comes in contact and changes it into some chemical form in which the blueberry plant can make use of it. Such a transformation is analogous to that already well known to occur in the root tubercles of leguminous plants. It is quite within the range of possibility that mycorhizas, as these structures are called, consisting of a root and its symbiotic fungus, will ultimately be proved to have a very high place in agriculture as nitrogen purveyors, second only in importance to these same leguminous tubercles.

BLUEBERRIES THRIVE ONLY IN VERY ACID SOIL

The writer's experiments with blueberries, which extended over a period of four years, covered a great diversity of soil mixtures, nutrient solutions, methods of potting, amount of shade, and day and night temperatures. Glass pots were much used, to facilitate the study of the roots. A hole was bored in the bottom to give the necessary drainage, and the glass was darkened by a removable cuff of opaque gray blotting paper. The use of these glass pots resulted in an intimate knowledge of the behavior of blueberry roots under different soil conditions, which could not have been secured in any other way and which was essential to the correct interpretation of the experiments.

In a rich garden soil in which alfalfa seedlings and rose-cuttings grew luxuriantly the blueberry plants stagnated, but in an acid soil the blueberries became large and vigorous, while roses and alfalfa starved and died. Alfalfa is exceedingly sensitive to acidity and cannot be grown with success in soils that have not a somewhat alkaline reaction. When grown in the humid eastern United States, alfalfa is rarely successful, except on calcareous soils, unless the natural acidity of the soil has been neutralized by suitable applications of lime.

Heavy manuring, also, is injurious to the blueberry. Six blueberry seedlings were transplanted into glass pots in a good blueberry soil, and six more seedlings were potted in the same manner, except that to each two parts of blueberry soil one part of well-rotted cow manure was added. At first the manured plants appeared, superficially, to be doing better than those not manured, for in the former the production of new leaves and the continued growth of the stem were not interrupted by the potting, while in the plants not manured there was a temporary but definite stoppage of stem growth immediately after the potting. The apparent superiority of growth in the manured plants, above ground, continued for about three weeks. Below ground, however, the roots of the two cultures showed directly opposite results. In the plants without manure, new root growth began a few days after potting. At the end of three weeks the development of an extensive root system was well under way and the plants were ready for a period of vigorous stem growth. In the manured plants, however, either no new root growth took place or only a slight amount. The old rootlets turned brown and appeared to be dead or dying. At the end of five weeks the growth of the tops was very slow. About ten days afterward, on a bright, warm day, the lower leaves on three plants withered, and within a few weeks all six of the manured plants were dead.

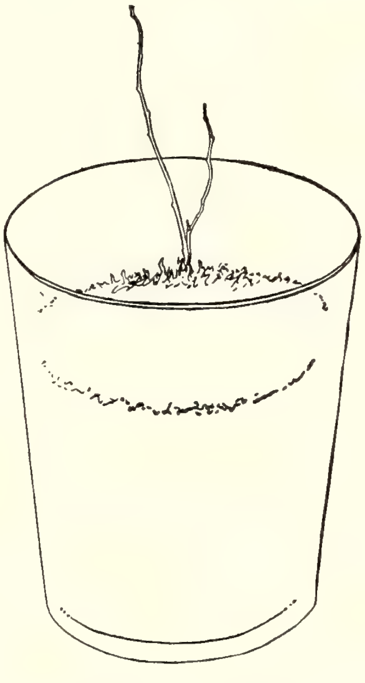
Except in acid soils the roots of the blueberry are subject to decay, their whole action indicating that the rotting is caused or aided by injurious bacteria and fungi. In good blueberry soils, however, these organisms are apparently killed or held in check by the acids that exist naturally in such soils.

EXPERIMENTS WITH LIME

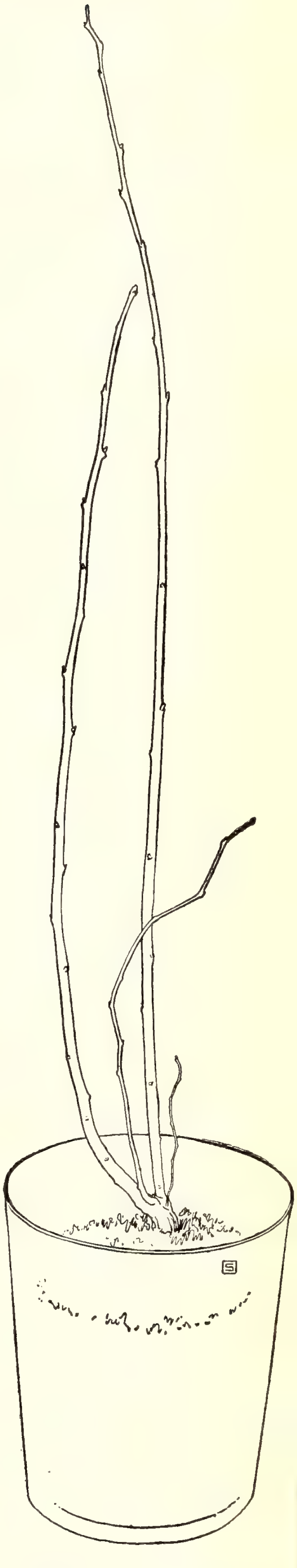
Although the application of lime to ordinary agricultural crops has usually a marked beneficial influence, the thorough liming of a good blueberry soil was found to have a very injurious effect on blueberry plants, similar to heavy manuring. In the course of these experiments with lime a remarkable phenomenon was produced, which, though having no important bearing on blueberry culture, is of very great significance to agriculture in general.

From some imperfect early experiments with lime the writer had erroneously concluded that the blueberry was so exceedingly sensitive to lime that the slightest admixture of it in the soil would be immediately fatal to a blueberry plant. Later experiments showed that lime was injurious to the blueberry only when in sufficient amount to neutralize the acidity of the soil, one per cent usually being adequate. But, before these later experiments had been made, and while still laboring under an erroneous conception of the supersensitiveness of the blueberry plant to lime, the writer, desiring to produce fresh examples of this phenomenon, placed a very small quantity—a few milligrams—of air-slaked lime on the surface of the soil in each of three 2-inch pots containing a small blueberry plant. No effect was produced, either at first or for several weeks.

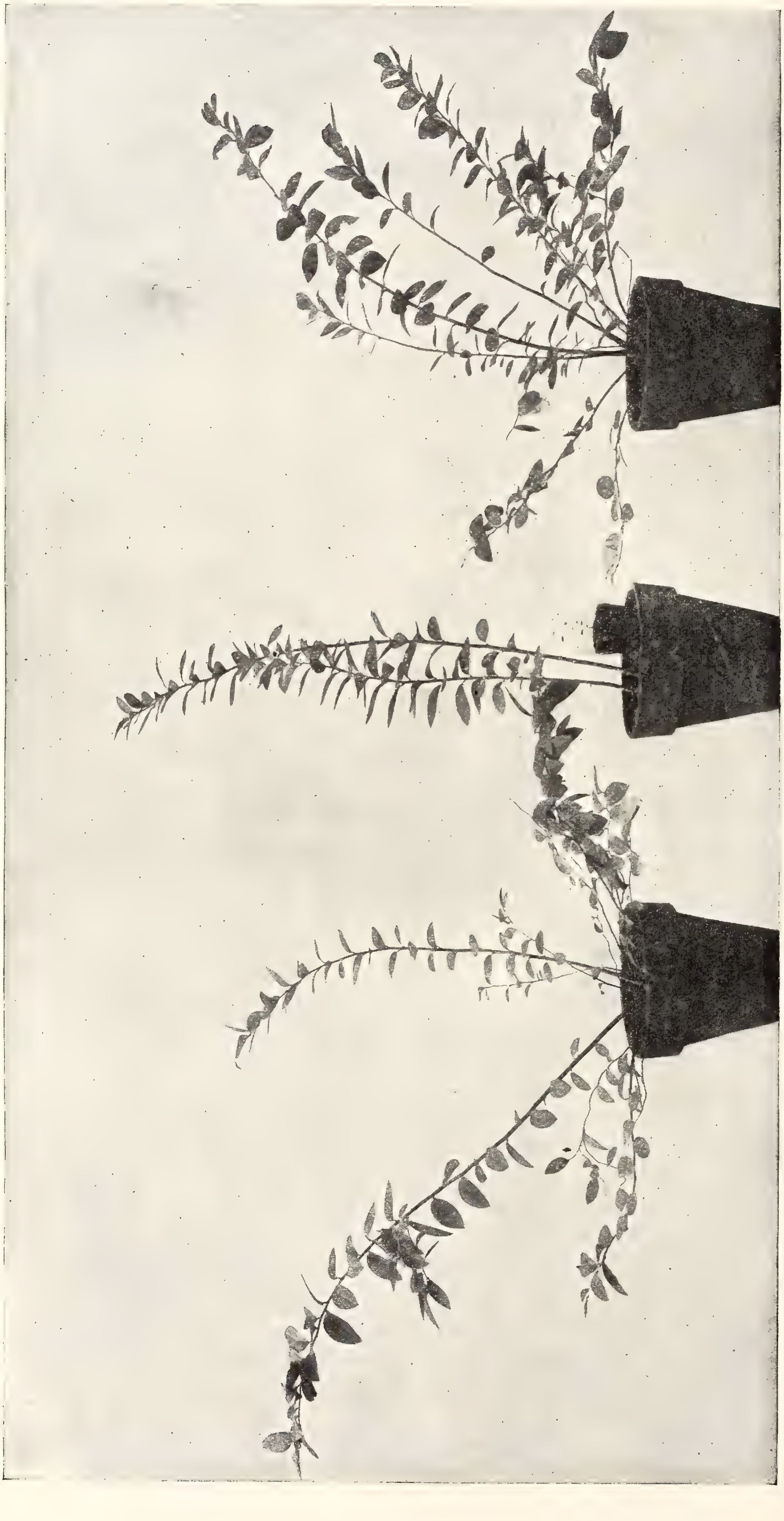
A large surface application of carbonate of lime was then made to the same three plants, a gram to each pot, and the lime was washed down with water. The expected collapse did not occur. The limed plants continued to grow as luxuriantly as their unlimed neighbors. The conclusion was reached that the reason why the growth of the plants had not been affected was because the lime had not penetrated sufficiently into the soil. Another and more drastic experiment was therefore determined upon.



Blueberry seedling in rich garden soil. (One-half natural size.)



Blueberry seedling in peat mixture. (One-half natural size.)



LARGE ONE-YEAR-OLD SEEDLINGS OF THE SWAMP BLUEBERRY

All three plants, grown in pure upland peat, are over 24 inches high, the one at the left 27 inches. The middle plant has been pruned. Standing on the middle pot is a small glass pot containing a seedling of the same age as the others, but grown in a rich garden soil. (One-eighth natural size.)

Six seedling blueberry plants in 4-inch pots containing a good acid blueberry soil were set apart from their fellows and watered exclusively with ordinary lime-water. The applications were of such an amount that the soil in the pot was thoroughly wetted each time, and usually a small excess quantity ran through the hole in the bottom of the pot.

For more than seven months these pots received no other water than lime-water. During this period the plants continued to grow in a normal manner, their average height increasing from 4½ to 14 inches. The lime appeared to have no deterrent effect whatever on the growth of the plants. An analysis of the soil in one of the pots showed that it contained over 8 per cent of lime, or the equivalent of an application of 25 tons per acre, an enormously excessive amount from the standpoint of agricultural usage.

The blueberry plants ought to have been dead long before. As a matter of fact they were making excellent growth. A careful examination of the contents of one of the pots was then made. The surface of the soil was found to be covered with a hard gray crust of lime. Immediately underneath for a depth of about half an inch the soil was black and contained no live blueberry roots. Beneath this the peaty soil was dark brown and filled with growing, healthy roots. The lime appeared to have penetrated only into the superficial portions of the soil. A chemical test confirmed this, showing that the black, rootless upper layer was densely impregnated with lime, while the brown, peaty portion containing the growing roots still gave the acid reaction that was characteristic of the whole potful of soil before the lime-water applications began.

Since all the water that the limeless, root-bearing portion of the soil had received during the preceding seven months had come from the lime-water applications, it was evident that the lime contained in the lime-water had been deposited in the upper half inch of the soil. The following laboratory experiment confirmed this: A 2-inch glass pot was filled to the depth of three-fourths of an inch with the acid upland peat used in growing blueberries. The peat was slightly moist and of rather fine texture, having been rubbed through an eighth-inch sieve. Then ordinary lime-water reddened by the addition of phenolphthalein—a substance giving a delicate color test for alkalies such as lime—was poured upon the soil. The excess water that filtered through the soil and came out of the hole in the bottom of the pot was wholly devoid of red color and, when submitted to a further chemical test, showed not a trace of lime. The precipitation of the lime by the soil had been not only complete but practically instantaneous. Only 15 seconds had elapsed between the time when the lime-water was added to the soil and the time when the liquid, entirely free from lime, began to drop from the pot.

This experiment has a very important bearing on the method of applying lime to acid soils in ordinary agricultural practice. A surface application of lime would have no appreciable effect in neutralizing the acidity of a soil unless the soil were so sandy, or gravelly, or otherwise open that the rain-water containing the dissolved lime could run down through it practically without obstruction. A surface dressing of lime would have little effect in neutralizing the acidity of an old meadow or pasture. To secure full action of the lime, as now generally recognized in the best agricultural practice, requires its intimate mixing with the soil, such as is accomplished by thorough harrowing, especially after putting the lime beneath the surface with a drill.

WHERE TO LOOK FOR BLUEBERRIES

The favorite type of acid soil for the swamp blueberry is peat. The peat chiefly used in the experiments was not, however, a bog peat, but an upland peat formed of a half decomposed mass of mixed leaves of oak and laurel (*Kalmia latifolia*). This accumulates for years in thickets of laurel, if fire is kept out, making a layer often 2 to 6 inches in thickness, the lower portions matted together by the fine, interlacing surface roots of the oak trees and laurel bushes.

When the leaves of trees are piled together and left to rot they gradually change, in from two to five years, from their initial state of pronounced acidity and brown color to a black, mellow, non-acid mold in which all traces of leaf structure have disappeared. Through a similar but more rapid process of decomposition pass the fallen leaves of a forest when underlain by a soil which is rich in lime or for any other reason has an alkaline reaction. Such a black mold occurs in the rich woods in which trillium, spring beauty, blood-root, and erythronium delight to grow. This soil is non-acid and fertile, and ordinary agricultural plants grow luxuriantly in it.

When, however, a forest is underlain by a sandy or granitic soil, in which there is not sufficient lime or equivalent substance to neutralize promptly the acidity of the decaying leaves, the normal progress of decomposition lags. Apparently the micro-organisms which cause the rotting of the leaves are not able to do their work so efficiently while the leaves remain acid, and when the next year's leaf-fall occurs they are deluged with new leachings of acidity. A permanently acid condition of the leaf litter is thus established, such as prevails in various types of forest. Such acid lands have a flora of their own—such plants as trailing arbutus, laurel, the azaleas, wintergreen, blueberries, huckleberries, the purple lady's slipper, and many others.

Thus it is that the swamp blueberry occurs not only on sphagnum-cushioned hummocks of peat in bogs, but on sandy uplands in upland leaf peat. When found in such places the plant commonly bears another name—the highbush blueberry. The essential feature of similarity in the two situations is their acidity and wherever the plant goes it follows an acid soil.

The geographic distribution of blueberries, huckleberries, and their relatives indicates their adherence to naturally acid soils. They occur in abundance from Maine to Florida in the sandy coastal plain, the prevailingly acid character of which is now well known through the conclusive experiments of Dr. H. J. Wheeler, of the Rhode Island Agricultural Experiment Station. They occur generally through the cool, humid hill-lands of New England, the acidity of which is notorious. They occur in sandy pine barrens and peat bogs throughout the eastern United States, both of which are acid. They are absent, on the contrary, from limestone soils, rich bottom lands, and rich woods where the soils are neutral or alkaline. In the lower elevations of the whole subarid West, where acid soils are almost unknown, these plants do not occur. Within reach of the fogs and heavy rainfall of the Pacific coast, or on the higher mountains of the interior, where conditions favor the development of acid soils, blueberries occur again in characteristic abundance.

CULTIVATING BLUEBERRIES IS EVIDENTLY VERY PROFITABLE

The experiments in field culture, as distinguished from the experiments with potted plants, have been in progress for but a short time, and only after the lapse of several years can definite statistics of yield, cost, and profits be given. The preliminary announcement of these experiments, however, has brought out one very interesting bit of information, namely, that a 5-acre bog near Elkhart, Indiana, set with wild blueberry bushes about 20 years ago has for many years produced large crops of berries, the area yielding in some years a clear profit of more than $100 an acre. The berries are sold at 15 to 18 cents a quart, and 5 cents a quart is paid for picking.

This is the only instance known to the writer in which the cultivation of the blueberry has heretofore been attempted on an acreage scale. Without further experience it is impossible to say whether this yield is larger or smaller than may

BLUEBERRIES GROWN IN A GREENHOUSE (NATURAL SIZE)

reasonably be expected of a blueberry area under good management. It is of some significance, however, that according to the reported yield the bushes in the Elkhart bog, which are set 6 by 6 feet, average about a quart of berries each in a good year, while in almost any good blueberry pasture in New England exceptional wild bushes may be found that produce from 4 to 6 quarts of berries each. It is to the selection and propagation of such productive plants with large, attractive, and fine-flavored berries that experimental culture should devote itself. The propagation of bushes with berries over half an inch in diameter is already actually in progress.

The only fruit the culture of which bears any resemblance to that of the blueberry is the cranberry. The two plants are closely related botanically; they both require an acid soil, and they both have a mycorhizal fungus on their roots, essential apparently to their successful culture. Cranberry-growing is a highly specialized and profitable industry, the development of which has required nearly a century of experimentation. It is only within the last few years that any really scientific attention has been paid to cranberry culture, the development of the industry having been accomplished by commercial growers. Progress in learning to handle the plant has therefore been slow and costly, but highly practical, and cranberry culture has much of experience to offer, by way of suggestion, to blueberry culture.

In preparing a bog for cranberry-growing the water level is lowered at least a foot below the surface by ditching; then a few inches of the top soil are removed by a process known as "turfing," which carries away all the native vegetation, and the naked peat is smoothed and covered with a few inches of clean sand. In this the cranberry plants are set. The provision of ponds or reservoirs to permit the rapid flooding of the bog completes the initial equipment. Such treatment of land is expensive when well done, costing perhaps $400 an acre. But a first-class cranberry bog in full bearing is often valued at $1,000 an acre, and each acre may be expected to produce a gross revenue of $300 per year, sometimes twice that amount.

A bog thus prepared promises to be an ideal situation for the swamp blueberry. Whether the profits would warrant the expenditure of so much money remains to be seen; but the expense may be reduced to a minimum by cutting out the turfing, sanding, and reservoir building, the blueberry plants being merely set in holes dug in the bog, after drainage, at intervals of about 8 feet each way.

Another sort of situation that gives experimental promise is a sandy, well-drained, but permanently moist upland possessing a distinctly acid soil. The plants should be set in trenches or separate holes filled with peat to the depth of about a foot. The surface should be well mulched with leaves or clean sand, and a deep mulch of leaves, preferably oak, should be added each year. The excavations should provide ample space for new growth of the roots, not less than a foot each way from the surface of the old root-ball.

The peat used may be taken from the surface of a bog containing plants of the heather or blueberry family, or it may be an upland peat, such as that described on page 144. In either case it should be gathered, piled, and rotted for several months before using.

The soil in which the holes or trenches are made should be such as will give good drainage, the ideal condition of the peat about the roots of the plant during the growing season being one of continued moisture, but with all the free water draining away readily so that thorough aëration of the mass of peat is assured.

To secure a stock of blueberry plants, the simplest method is to transplant wild bushes in early spring, before the buds have begun to push. The roots usually lie within the upper 6 inches of the soil. A disk of this root and soil mat as large as practicable should be taken up with the bush.

If the experimenter has a greenhouse at his disposal he can raise seedlings, which will be ready for field-planting in the spring of their second year.

Seedling bushes are unsatisfactory in one respect. They are not exactly like the parent. The seedlings from a large-berried bush do not all bear large berries. Selected forms of special merit have been propagated by budding and by grafting, just as our highly developed varieties of apples are perpetuated; but in the blueberry the stock is continually sending up new shoots from points below the graft. As blueberry culture develops it will undoubtedly become the practice to propagate the best varieties by layering or by cuttings, as has already been done, for by these methods the whole plant body, including the roots, is of the variety desired, and alien shoots can never be produced.

BLUEBERRY BUSHES LIVE MANY YEARS

As to the time required for a blueberry seedling or cutting to come into profitable bearing, experience cannot yet give a definite answer. They should bear a few berries the second and third years. It is believed they will bear profitable crops, under proper culture, in 5 to 10 years. They ought to remain in bearing for a long time. In some instances wild bushes undoubtedly live, in favorable situations, for 50 to 100 years. They are enabled to reach such an age by continual rejuvenescence through their habit of sending up new stems from the root to replace old and dying ones. Those who are curious to know how large an old blueberry bush may become should read Thoreau's description of one in his Winter Journal, under date of December 24, 1859.*

One interesting feature of blueberry culture is the cheapness of the lands on which they thrive best. Bog lands and sandy lands well suited to the blueberry can be bought in many parts of New England for $1 to $5 an acre, and this because the very reason that makes them good for blueberries—their acidity—has made them almost worthless for ordinary agricultural purposes.

Some reader will ask, "Do you advise me to go into blueberry culture?" My reply is, the industry is so new and so many unforeseen difficulties are bound to arise that, until the details of successful field management have been worked out, blueberry-growing is not recommended as an industry to any one who cannot afford to lose both the time and the money he may put into it. On the other hand, if one does succeed in carrying the thing through successfully, he may expect good returns from his venture, for the Elkhart farmer, while apologizing for his poor blueberry crop of 1910, which was "almost a total failure" on account of the late spring freezes, says nevertheless that he got 65 16-quart crates of berries, which he sold at an average price of $2.75 a crate—an item of $178.75 from an otherwise useless 5-acre bog.

I remarked to a friend that blueberry culture promised to be comparable in many respects with cranberry culture. He quite outran the idea that was in my mind by replying, "Why, it has the cranberry beaten. You can't use cranberries without buying a turkey to eat with them."

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* December 24, 1859. . . . I measure the blueberry bush on Fairhaven Pond Island. The five stems are united at the ground, so as to make one round and solid trunk thirty-one inches in circumference, but probably they have grown together there, for they become separate at about six inches above. They may have sprung from different seeds of one berry. At three feet from the ground they measure eleven, eleven, eleven and one-half, eight, and six and one-half or on an average nine and one-half inches. I climbed up and found a comfortable seat, with my feet four feet from the ground. There was room for three or four more there, but unfortunately this was not the season for berries. There were several other clumps of large ones in the neighborhood. One clump close by the former contained twenty-three stems within a diameter of three feet, and their average diameter at three feet from the ground was about two inches. These had not been cut because they stood on this small island which has little wood beside, and therefore had grown thus large. . . .

The stems rise up in a winding and zigzag manner, one sometimes resting in the forks of its neighbor. Judging from those whose rings I have counted, the largest of those stems must be about sixty years old.—BLAKE, H. G. O. (editor). Winter: From the Journal of Henry D. Thoreau, 16-17. 1888.

THE PANAMA CANAL*

By Colonel George W. Goethals, Chief Engineer of the Panama Canal

IT is not possible in the time at our disposal to enter upon a description of the explorations and investigations which were made of various routes proposed for a canal joining the two oceans, nor can an account be taken of the considerations which resulted in the United States finally adopting the Panama route. Suffice it to say that under the Spooner Act, approved June 28, 1902, the President of the United States secured the necessary concession from the Republic of Panama, purchased the rights and property of the New French Canal Company, and undertook the construction of the canal on May 4, 1904.

The Isthmus of Panama runs nearly east and west, and the canal traverses it from Colon on the north to Panama on the south, in a general direction from northwest to southeast, the Pacific terminus being 22 miles east of the Atlantic entrance.

TORRENTIAL FLOODS OF THE CHAGRES RIVER

The greatest difficulty of the Panama route is the control or disposition of the Chagres River and its tributaries. The Chagres River rises in the San Blas Mountains and drains a basin of 1,320 square miles, about half of which is above the mouth of the Obispo River. Its course is generally parallel to the Caribbean coast line so far as the mouth of the Obispo, where it turns almost at right angles to the westward, pursuing this general course to Tabernilla, whence it traverses a tortuous channel in a general northwesterly direction and enters the Caribbean Sea to the west of Limon Bay.

The general elevation of the valley is but little above sea-level to Bohio, where the low-water surface of the Chagres is one foot above mean tide. At the mouth of the Obispo, 13 miles from Bohio, the low-water surface is 48 feet above, and at Alhajuela, 11 miles farther, it is 95 feet above the same datum. Above Bohio the Chagres Valley is undulating, the hills becoming higher and steeper as the river is ascended, causing very rapid run-off of the rains, amounting to 100 inches and over in eight or nine months, the average duration of the wet season.

The maximum observed rainfall is 5.86 inches in one hour; the greatest recorded change in the river at Gamboa is a rise of 25.6 feet in 24 hours. Its discharge at the beginning of the rise was 8,200 cubic feet per second, increasing to 90,000 cubic feet per second at the peak of the flood. The excessive rainfall and precipitous character of the hills enclosing the valley make it a torrential stream. The bars formed during floods differ materially, and are of sand, gravel, pebbles, and rounded stones three inches to six inches in diameter. The sand and clay deposits are useful in giving suitable material for the impervious portion of the dams, while the gravel beds furnish ballast for the railroad and for other purposes.

The Chagres River has 26 tributaries between Bas Obispo and Gatun, the largest of which are the Gatun and Trinidad rivers, the former entering from the east with a drainage basin of about 160 square miles, and the latter from the west, draining an area of about 390 square miles. Each rises in the same character of country as the Chagres, and though with smaller drainage areas, they are of the same torrential character and must be reckoned with in the general question of the control of the Chagres and its tributaries.

Various methods for the disposition or control of the Chagres have received consideration. The first French company, in its attempt to cut a sea-level canal, found it necessary to provide diversion channels to care for the water of the rivers. The New Panama Canal Company adopted the plan of a dam across the river valley at Bohio, creating a lake above this point and discharging the flood waters to the level below by means of a spillway in the adjacent hills. The canal which the President was authorized to construct by the provisions of the Spooner Act was the lock type recommended by the first Isthmian Canal Commission in its report submitted November 16, 1901. This plan also provided a lake for controlling the Chagres by a dam at Bohio, following along the plans of the New Panama Canal Company, thereby utilizing to the fullest extent the work already accomplished.

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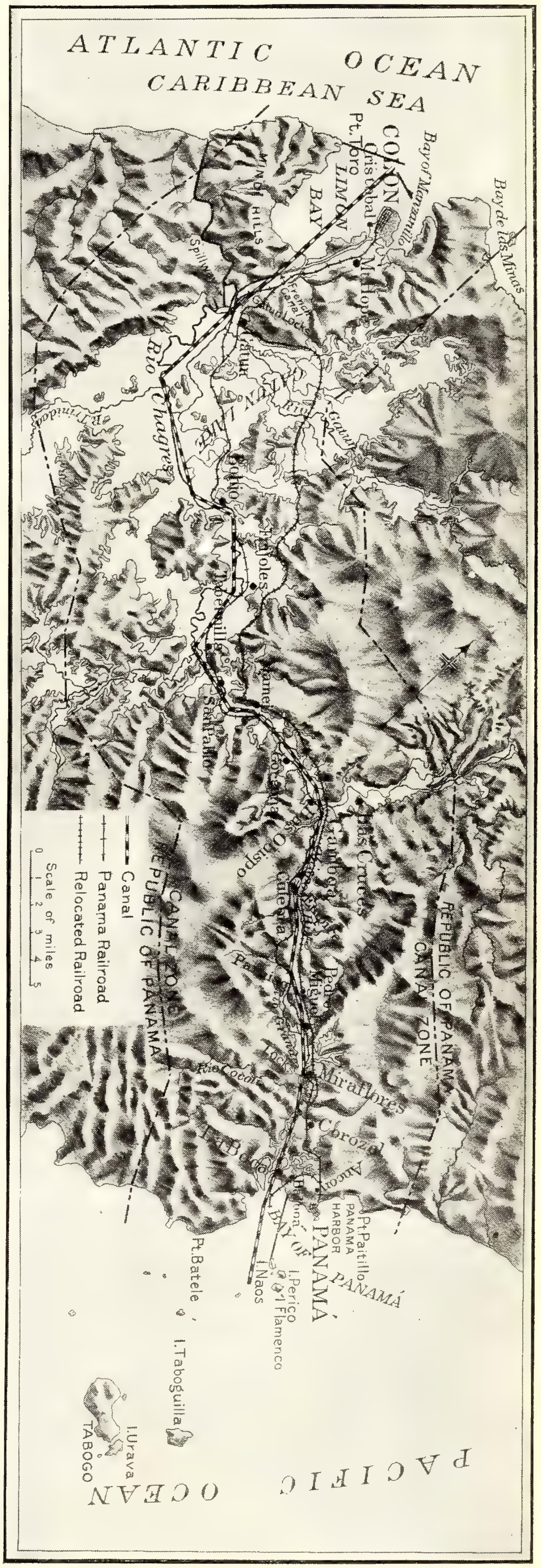
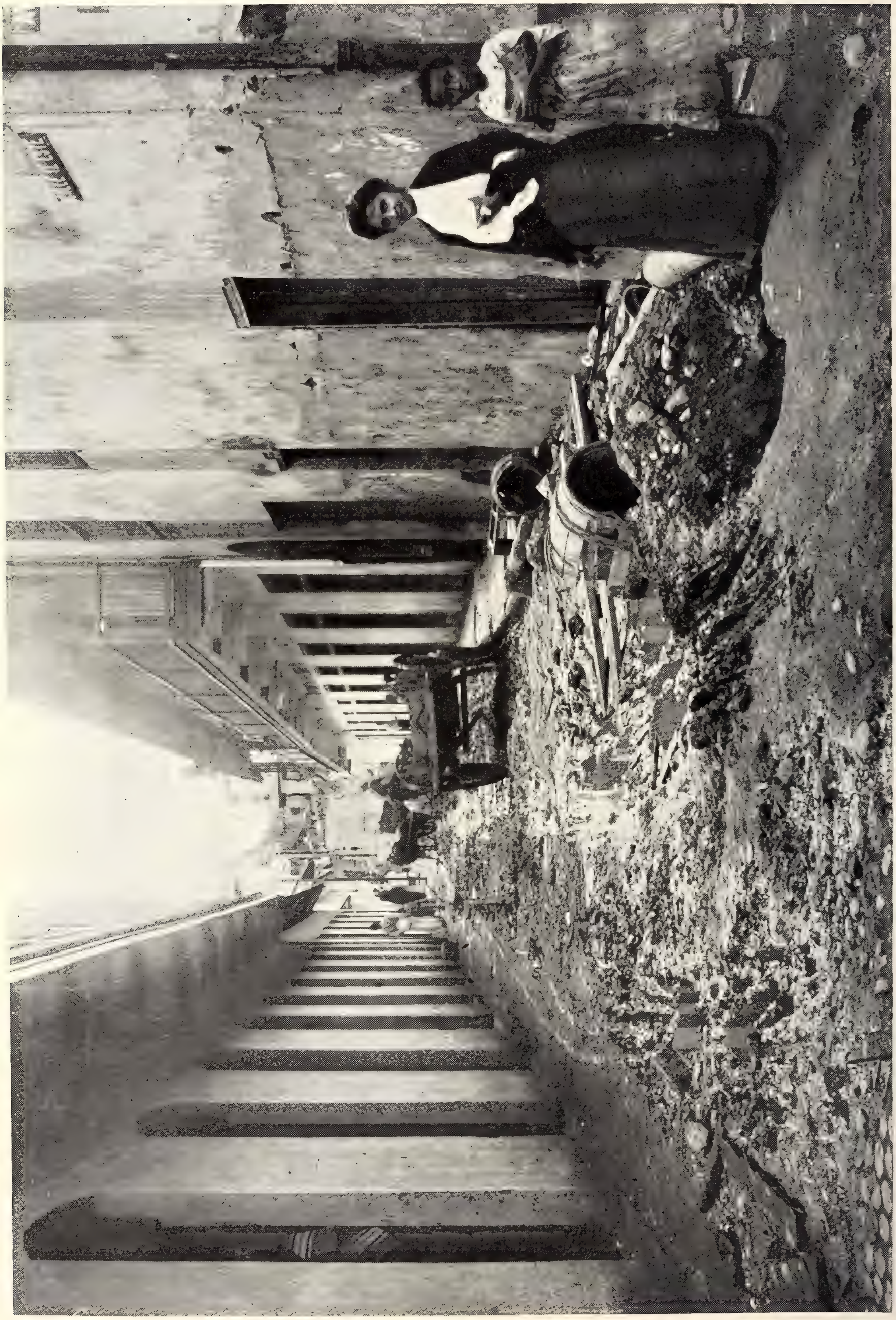
* An address to the National Geographic Society, February 10, 1911.

Early in the progress of the work the construction of a sea-level canal was agitated; this is undoubtedly the ideal canal. It took such a hold on the public mind that, in consideration of the international importance of the work, the President convened a Board of Consulting Engineers to consider and report upon the type of canal which should be adopted. This Board consisted of 13 members—five representatives of European countries and eight Americans—and assembled in Washington in June, 1905. The minority of this Board—five in number—reported in favor of the lock type for the reasons that such a canal would provide greater safety for ships and less danger of interruption to traffic by reason of its wider, straighter, and deeper channels, as well as quicker passage for large ships; the other considerations were that such a canal could be built in less time and for less money.

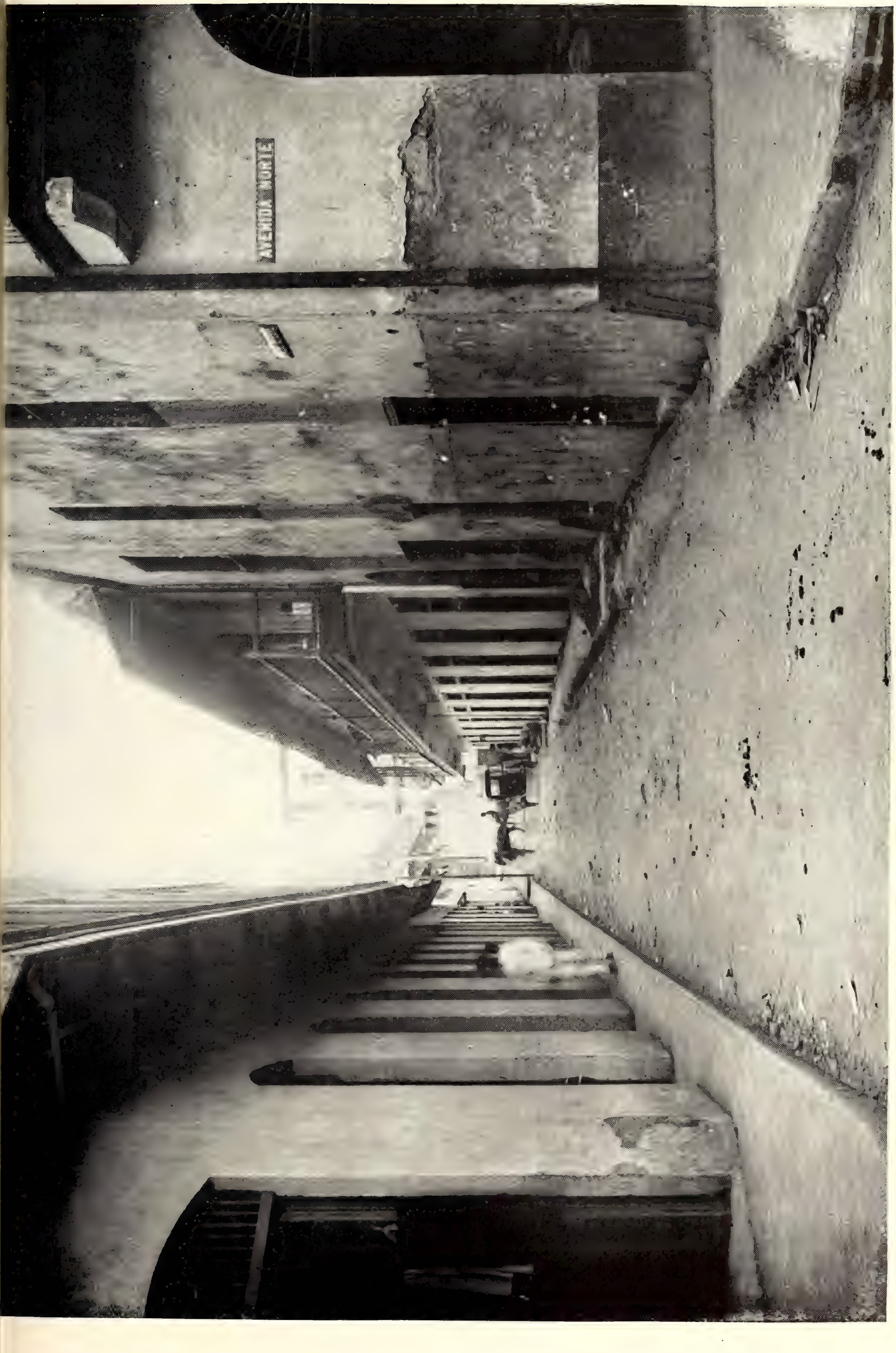
In forwarding the report of this Board to Congress, on February 19, 1906, the President stated: "The law now on our statute books seems to contemplate a lock canal. In my judgment a lock canal as herein recommended is advisable." On June 29, 1906, the Congress authorized the construction of the lock type of canal, in accordance with the general plans of the minority of the Board, and



MAP OF THE CANAL ZONE



A STREET IN THE CITY OF PANAMA AS IT APPEARED WHEN THE UNITED STATES OBTAINED CONTROL OF THE CANAL



THE SAME STREET REPAIRED BY THE AMERICAN ADMINISTRATION

All the streets of Panama and Colon have been renovated in a similar manner. Many miles of macadamized roads have also been built in outlying districts

THE CUSTOMARY LABORER'S MESS, BEFORE AMERICAN CONTROL

the work has since been carried on along these lines.

This conclusion was not generally accepted as satisfactory; the plan was again vigorously attacked after the settlement and slip in a part of one of the toes of the Gatun Dam in the latter part of 1908, and the "Battle of the Levels" continued well into 1909, notwithstanding the fact that the then President-elect, with a party of eminent engineers, after a personal inspection of the work advocated no change.

WISDOM OF CHOICE OF LOCK CANAL NOW GENERALLY ACKNOWLEDGED

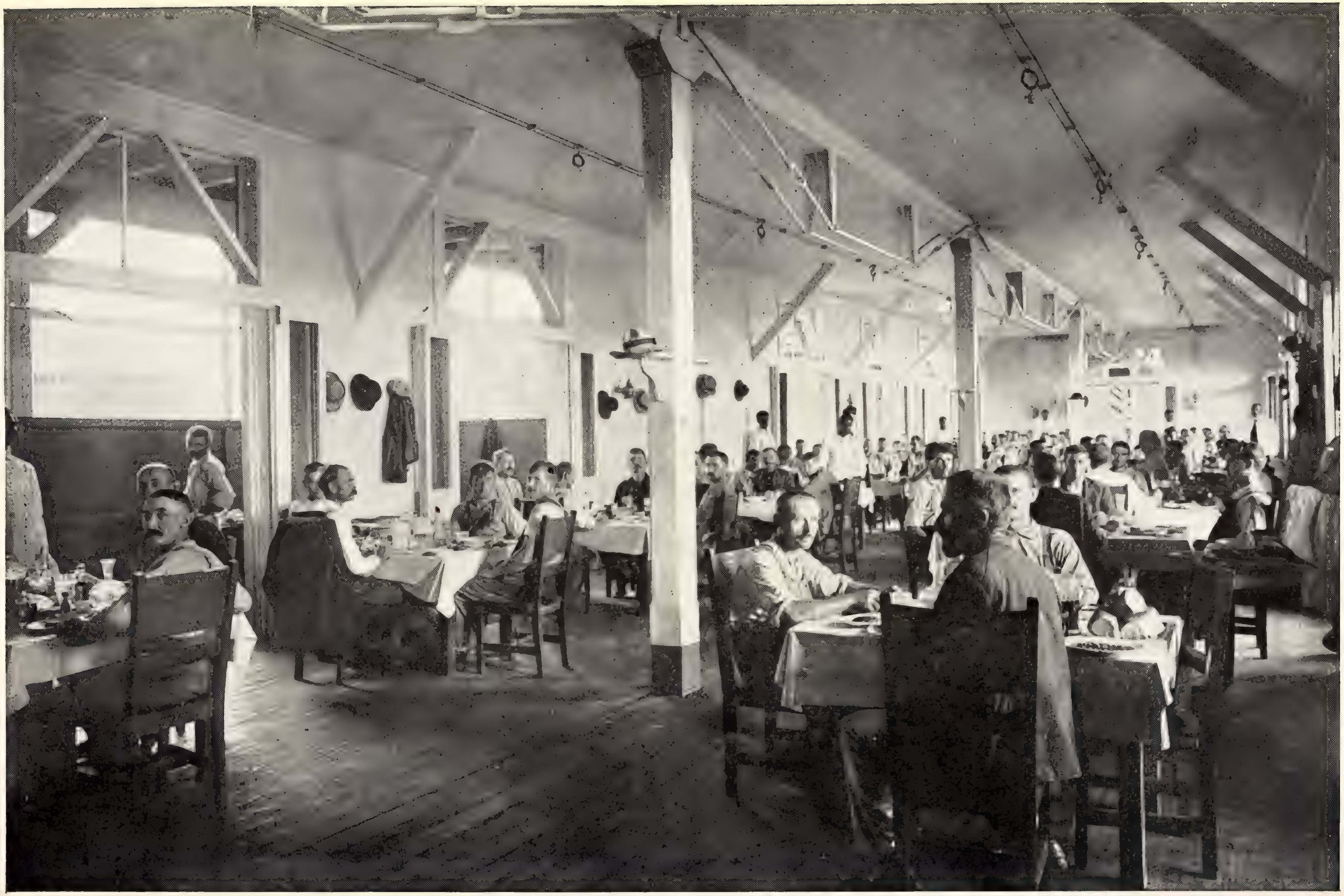
Since then, as the work has advanced, the wisdom of the choice is clearly shown and there is no doubt as to the ultimate success of the project. Developments within the last year in the form of slides have brought more prominently to the front the excellence of the judgment which accepted the minority plan in lieu of the sea-level plan as advocated by the majority, and show more clearly the greater difficulties that would be encountered in an attempt to construct a sea-level canal.

An English scientist, who has kept in close touch with the work since the Americans took charge, and who at first was skeptical as to the Gatun Dam, said, after a recent visit, that he was converted to the present plan because it is not a dam at all that is building, but a veritable hill. He also thought that the expressed opinion of the Board of Consulting Engineers with reference to the Gatun Dam, namely, "that no such vast and doubtful experiment should be indulged in," was now applicable to Culebra Cut. There are probably some who still believe a wrong choice was made, but a visit to the Isthmus is a sure cure for such cases, provided always that they are open to conviction.

In the present plan the control of the Chagres is also effected by a lake, but greater in extent, because the dam is located at Gatun instead of Bohio. This solution was first proposed by Godin de

LABORERS WAITING FOR THE MEAL HOUR AT ONE OF THE MESSES FOR THE "SILVER ROLL"

To avoid the color question, all employees are divided into two classes, those paid in gold, who form the "gold roll," and those paid in silver, the "silver roll." Americans and Europeans belong to the former, and the West Indians and Panamans to the latter. These men can get a meal ticket for 30 cents after they have done one-half day's work. The meal costs the Commission 27.29 cents.



MESS-HALL AT CULEBRA, IN WHICH MEN ARE PERMITTED TO EAT WITHOUT THEIR COATS

White laborers can get meal tickets for 40 cents each. The meal actually costs the Commission 36.84 cents. The net weight of the ration furnished the European laborer is exactly equal to the gross weight of the United States Army garrison ration, and the net weight of the ration furnished the negro laborer is exactly equal to the gross weight of the United States Army field ration.

Lépinay, a French engineer, who, in an exhaustive paper on the subject, prepared for the Congress of Engineers in Paris in 1879, advocated the construction of a lock canal with a dam at Gatun in lieu of a sea-level canal. The reasons which he advanced at that time were to the effect that such a canal could be built for less money, in less time, and with less sacrifice of life.

THE PRINCIPAL FEATURES OF THE CANAL

The canal which is now building consists of a sea-level entrance channel from the sea through Limon Bay to Gatun, about seven miles long, 500 feet bottom width, and 41 feet deep at mean tide. At Gatun the 85-foot lake level is obtained by a dam across the valley. The lake is confined on the Pacific side by a dam between the hills at Pedro Miguel, 32 miles away. The lake thus formed will have an area of 164 square miles and a channel depth of not less than 45 feet at normal stage.

At Gatun ships will pass from the sea to the lake level, and *vice versa*, by three locks in flight. On the Pacific side there will be one lift of 30 feet at Pedro Miguel to a small lake held at 55 feet above sea level by dams at Miraflores, where two lifts overcome the difference of level to the sea. The channel between the locks on the Pacific side will be 500 feet wide at the bottom and 45 feet deep, and below the Miraflores locks the sea-level section, about eight miles in length, will be 500 feet wide at the bottom and 45 feet deep at mean tide. Through the lake the bottom widths are not less than 1,000 feet for about 16 miles, 800 feet for about four miles, 500 feet for about three miles, and through the continental divide, from Bas Obispo to Pedro Miguel, a distance of about nine miles, the bottom width is 300 feet.

The total length of the canal from deep water in the Caribbean, 41-foot depth at mean tide, to deep water in the Pacific, 45-foot depth at mean tide, is practically 50 miles, 15 miles of which are at sea level. The variation in tide on the Atlantic side is 2.5 feet as a maximum, and on the Pacific it is 21.1 feet as a maximum.

Provisions are made to amply protect the entrances of the canal. During the winter months occasional storms occur on the Atlantic side, of such violence that vessels cannot lie with safety in Colon Harbor, and during the progress of such storms entrance and egress from the canal would be unsafe. To overcome this condition, a breakwater will extend out about two miles from Toro Point in a northeasterly direction, which will not only protect the entrance, but will provide a safe harbor. Whether protection on the east side will be ultimately necessary is still an open question.

The Pacific entrance requires no protection from storms, but the set of the silt-bearing current from the east is at right angles to the channel and the silting made constant dredging necessary. To prevent this shoaling a dike is being constructed from the mainland at Balboa to Naos Island, a distance of about four miles; the benefits derived from it are already very marked.

The projected lakes will submerge the tracks of the Panama Railroad for the greater part of its length, and as this road is necessary for construction purposes, and ultimately for the operation and maintenance of the canal, it is being reconstructed throughout, with the exception of a few miles at either end. It was originally intended to pass the new railroad through Culebra Cut on a berm, 10 feet above the water surface, to be left for this purpose during the excavation of the channel through the cut, but the slides and the absolute necessity for keeping open railroad communication between the two ends of the line necessitated a change in the location, and a new line to the east of the cut has been selected.

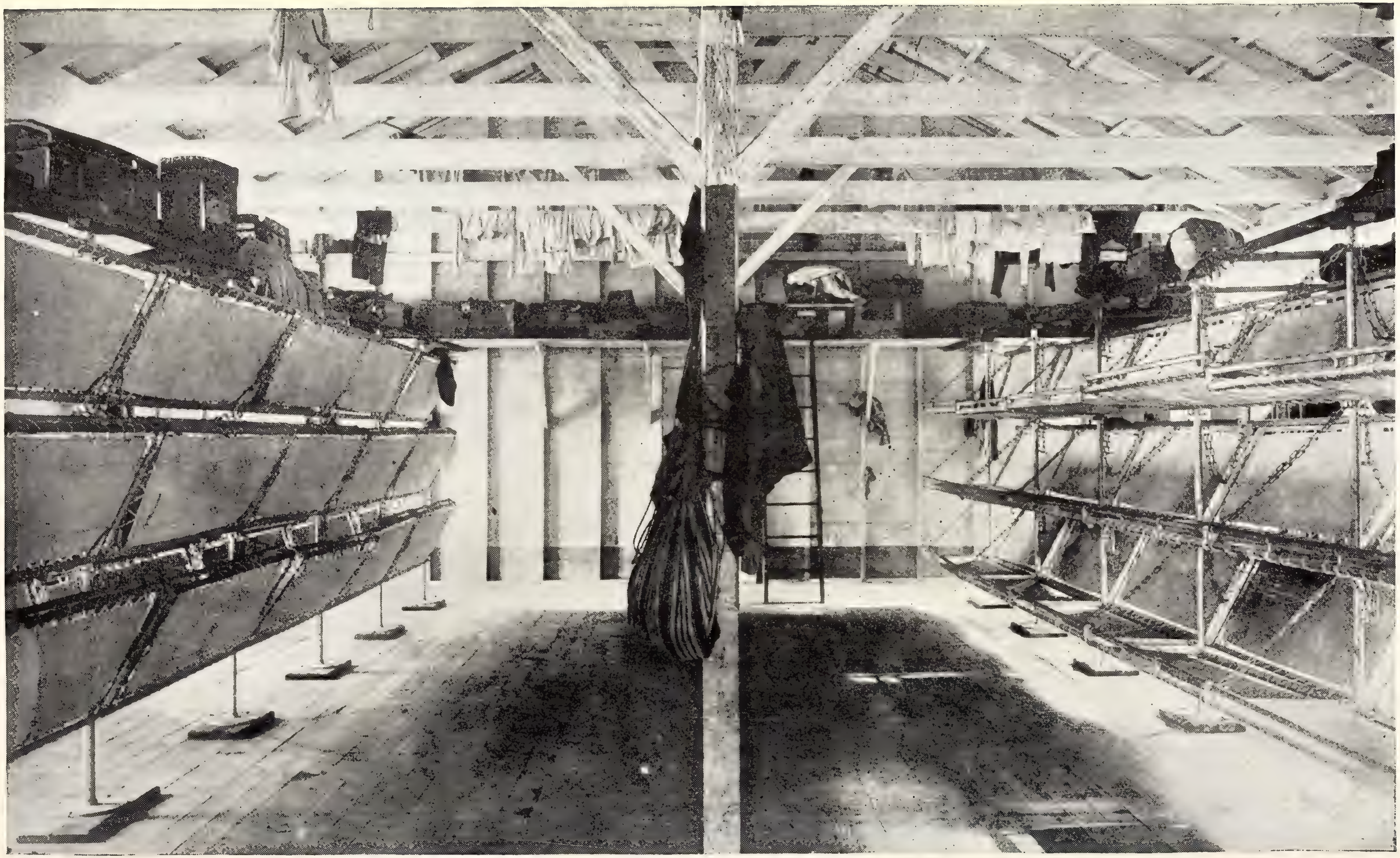
In order to hold its concession the French company continued work on the canal up to the time that the United States assumed control, and after the transfer of rights and property was formally made the excavation was carried

A GROUP OF ITALIAN LABORERS

These men are paid from 16 to 20 cents an hour

SPANISH LABORERS ON THE CANAL

The popularity of the work on the Isthmus has become so great that it is no longer necessary for the Canal Commission to bring in shiploads of recruits from the West Indies and Europe. Laborers are so attracted by the good pay, fair treatment, and excellent living conditions that more than 2,000 came from Spain and Italy during 1910. Old laborers who had left the work to go to Brazil and South American countries have also been returning to the Isthmus in large numbers, seeking re-employment. There are at present about 35,000 on the rolls of the canal works.



SLEEPING QUARTERS FOR EUROPEAN LABORERS, SHOWING THE THREE ROWS OF "STANDEE" BUNKS

The Commission maintains about 150 houses in which approximately 5,700 European bachelor laborers are quartered on by the United States with the various tools and appliances then in use.

MAKING THE ISTHMUS HEALTHY

The first two and a half years of American control were given to preparation. All energies were devoted during that time to rid the Isthmus of disease by sanitation, to recruiting and organizing a working force, and providing for it suitable houses, hotels, messes, kitchens, and an adequate food supply; to assembling the plant to do the work; to increasing the capacity of the existing railway system, and to establishing a system of civil government for the Canal Zone, which is a strip of land 10 miles wide (five miles on either side of the center of the canal), extending across the Isthmus.

The work of sanitation included clearing lands, draining and filling pools and swamps for the extermination of the mosquito, the establishment of hospitals for the care of the sick and injured, and the quarantine. In addition, to secure and maintain better health conditions, municipal improvements were undertaken in the cities of Panama and Colon, and the various settlements along the line of canal, such as the construction of reservoirs, with mains and adjuncts, for furnishing wholesome and sufficient water, sewerage, pavements, and a system of roads.

Buildings to the number of 2,009 were constructed, including office buildings, hospitals, hotels, messes, kitchens, shops, storehouses, and living quarters. In addition to this, 1,536 buildings out of a total of 2,200 buildings turned over by the French were remodeled and repaired for use.

Recruiting agencies were established in the United States, Europe, and the West Indies.

AN IMMENSE DEPARTMENT STORE

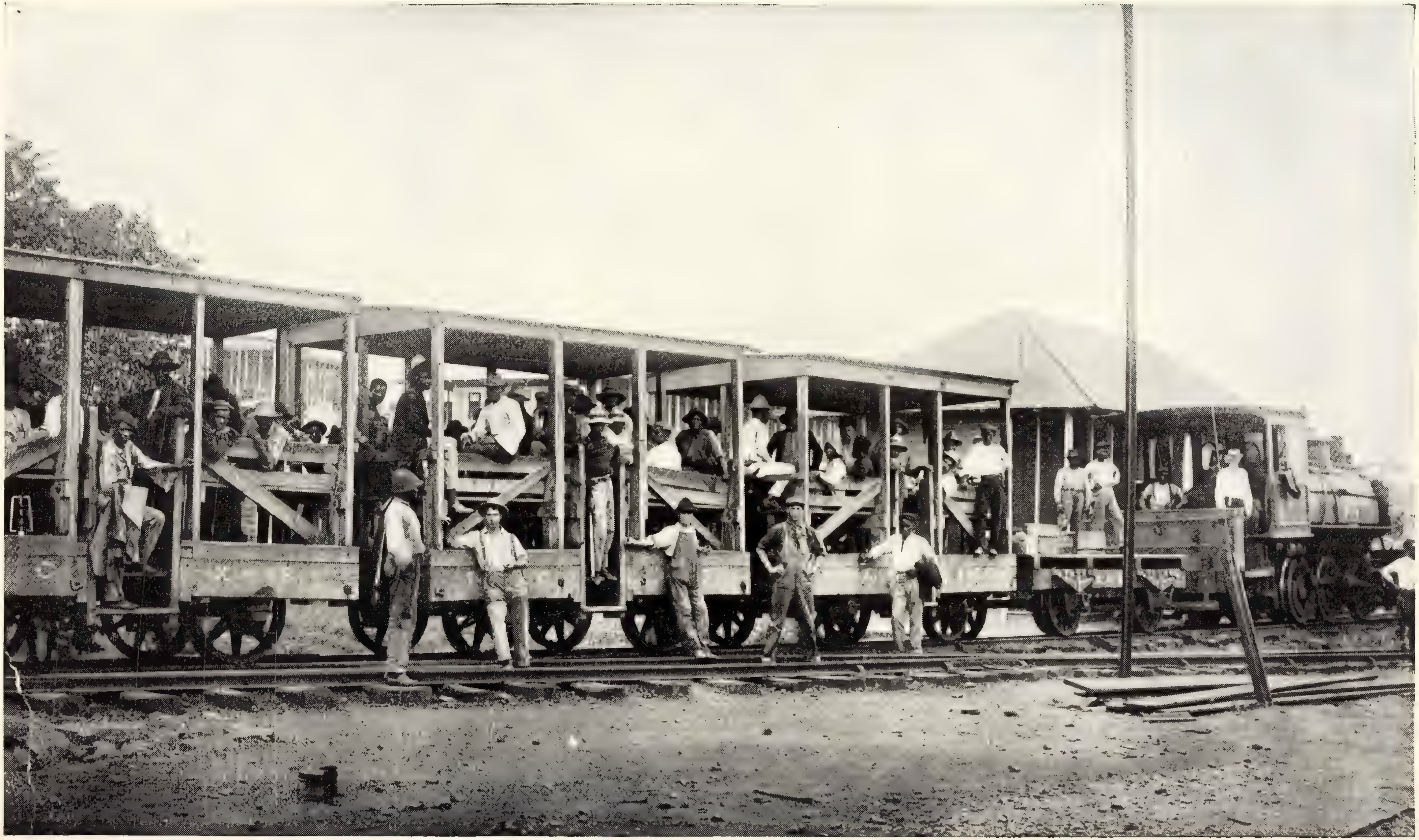
The Commissary Department of the Panama Railroad Company was enlarged until it is now a great department store supplying to the employees whatever may be necessary for their comfort and convenience. Manufacturing, cold storage, and laundry plants were established and turn out each day about 90 tons of ice, 14,000 loaves of bread, 2,400 rolls, 250 gallons of ice-cream, 1,000 pounds of roasted coffee, and 7,500 pieces of laundry. Four to five refrigerator cars, loaded with meats, vegetables, and such fruits as can be obtained, are sent out on the night freight to distant points, and every morning a supply train of about 16 cars, of which number six to eight are refrigerator cars, leaves Cristobal at 4.30 to distribute food-stuffs and laundry to the local commissaries along the line, where the employees make their purchases and where the hotels, messes, and kitchens secure their supplies for the day.

The construction plant, consisting of steam shovels, locomotives, cars, unloaders, spreaders, track-shifters, pile-drivers, cranes, dredges, steamboats, tugs, and barges, was purchased for the most part "knocked down," and shops for their erection and repair were constructed and enlarged. Some of the machinery was built from parts manufactured in the shops. The distance from the home market, with attendant vexatious delays in securing parts and material and the necessity for keeping the construction plant in the most efficient condition for economical operation, made it imperative that the shops be equipped to meet every possible contingency.

The capacity of the Panama Railroad, over a large part of which the spoil from Culebra Cut must be handled, was increased by double tracking it throughout, except from Cristobal to Gatun and from Culebra to Paraiso. Yards were enlarged and connections made to areas available for dumping grounds.

Laws were framed, and civil government was established with its necessary adjuncts of courts, police force, fire companies, customs and revenue service, post-offices, public works, and treasury.

A purchasing department was organized in the United States for the obtainment of supplies of all kinds and descriptions. Upon arrival on the Isthmus,



A TYPICAL LABOR TRAIN

Locomotive engineers are paid from $180 to $210 a month in United States currency; locomotive firemen from $50 to $60 a month, and common laborers from 10 cents to 20 cents an hour the supplies are shipped to the various subdivisions of the canal-work for which they were purchased, or they are placed in storehouses along the line for issue when required.

It was only after these various yet necessary adjuncts had been provided and the forces for their operation were organized that the principal work in hand—the building of the canal—could be pushed forward with any hope of success, and too much praise cannot be given to those who conceived and established them in a working condition.

The Department of Construction and Engineering is divided into three construction divisions. The Atlantic Division embraces the engineering construction from deep water in the Caribbean Sea to include the Gatun locks and dam; the Central Division extends from Gatun to Pedro Miguel, and the Pacific Division from Pedro Miguel to deep water in the Pacific Ocean.

KEEPING THE FLOODS OUT OF CULEBRA CUT

As already noted, the Americans continued the work in progress by the French in the cut through the continental divide, commonly known as the Culebra Cut, utilizing the French machinery until it could be replaced by more modern appliances. This is the most formidable part of the enterprise on account of the magnitude of the cutting, and also because of the difficulties attending it, due to the excessive rainfall and to the varying character of the materials encountered.

The efficient and economical working of the plant requires that provisions be made for the disposition of the large quantities of water that result from the rains. Whatever water is not carried off by the streams enters the cut, either through direct fall over the excavated area or by seepage into it. Proper drainage of the cut is therefore an ever-existing problem, and two distinct phases are presented, viz:

1. To keep out the water of the surrounding country.

2. To rid the excavated area of the water that collects in it.

A system of diversion channels accomplishes the first, and gravity drains and pumps solve the second. The canal line follows the Obispo River, which drains the area from the divide to the Chagres River. It has four principal tributaries, two from the east, the Masambi and the Sardinilla, and two from the west, the Mandinga and the Comacho. These are cared for by two diversion channels.

On the east side of the cut the Obispo diversion has been constructed almost parallel to the canal and carried through a depression in the hills so as to discharge into the Chagres about one mile above the point at which the canal line crosses the river.

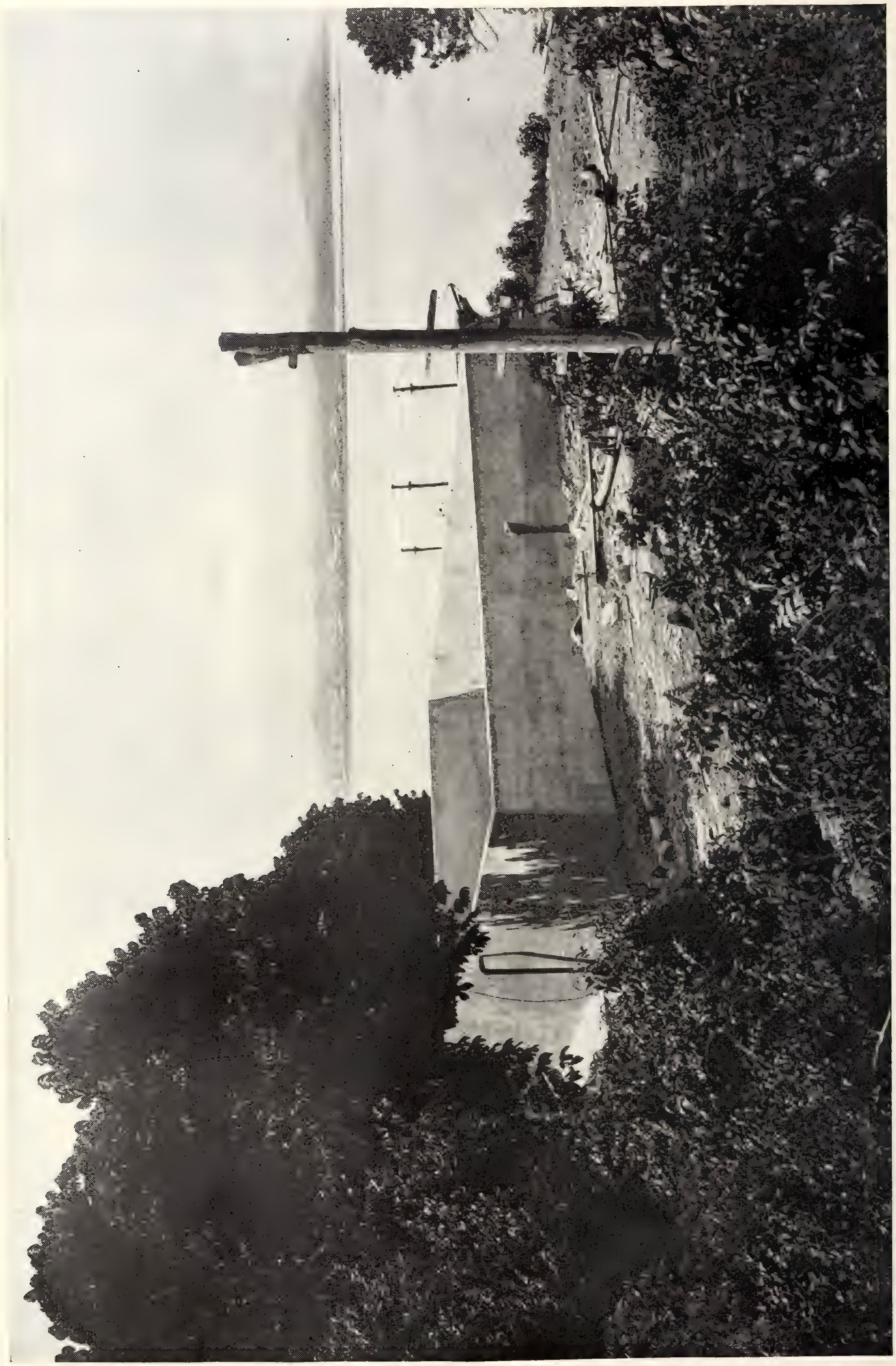
To the west of the cut the Comacho diversion carries the waters from Culebra to the Chagres River through the old channel of the Obispo River. Through a hill between Haut Obispo and Bas Obispo, which sharply deflects the river, the French had built a tunnel for diverting the flood waters, and this forms a part of the new diversion.

The canal follows the Rio Grande on the southern slope of the divide, and its waters are cared for by a diversion channel constructed by the French. They also constructed a dam across the valley, impounding the waters, and the resulting reservoir supplies the settlements from Culebra to and including Panama. During the wet season the diversion channel carries the overflow from the reservoir.

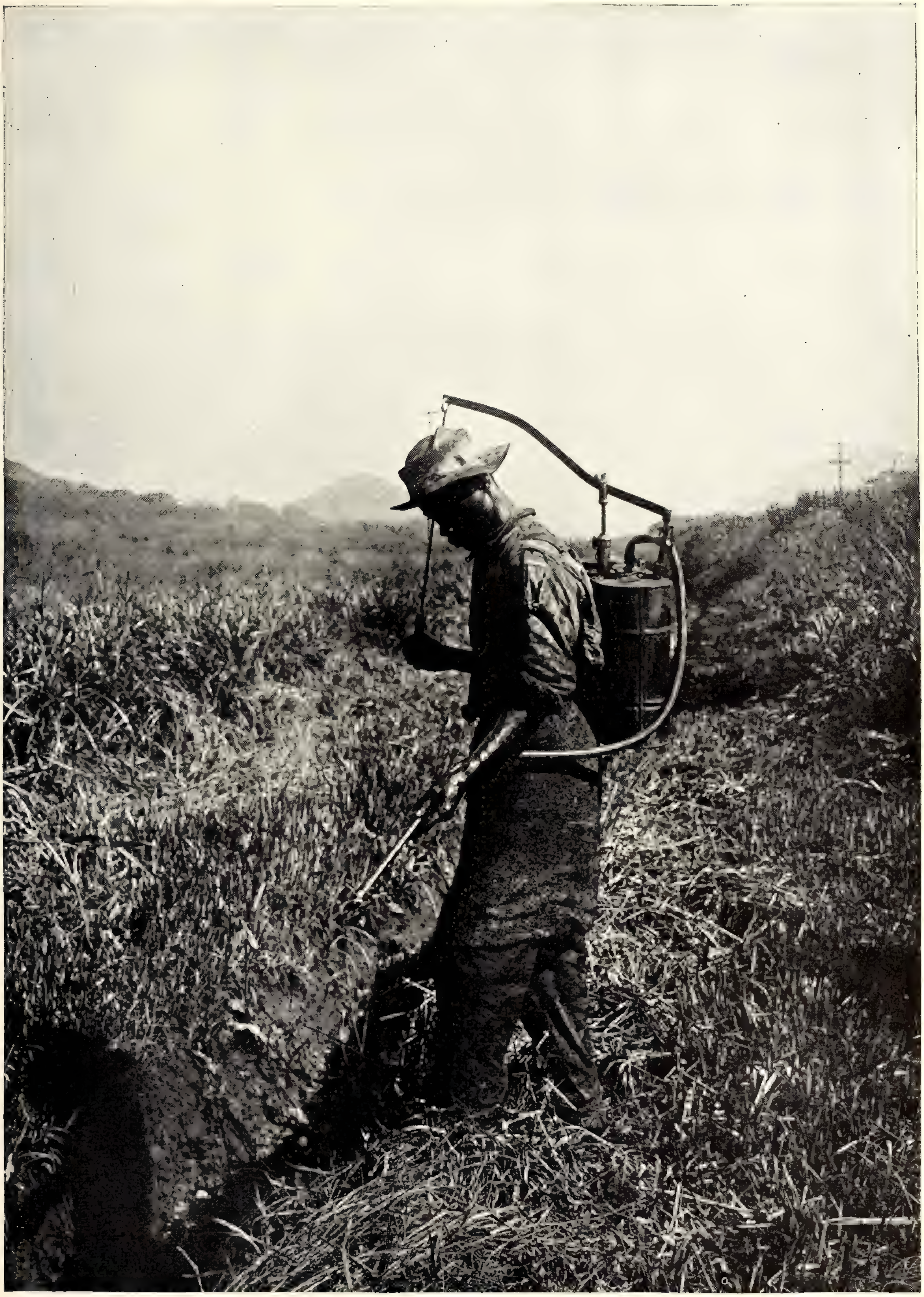
HOW THE SHOVELS WORK

The French so planned the excavation that after the removal of the peak of the divide and lesser summits they could work a number of excavators simultaneously at several points, so that a succession of benches resulted, lying one above the other, each with the natural surface as the point of beginning. By working in the direction of the length of the cut, the face of the bank gives the longest cutting possible, reduces the number of times the excavator must be hauled back, and secures a satisfactory drainage arrangement, since the cutting is carried up grade on either side of the summit.

The Americans have followed this



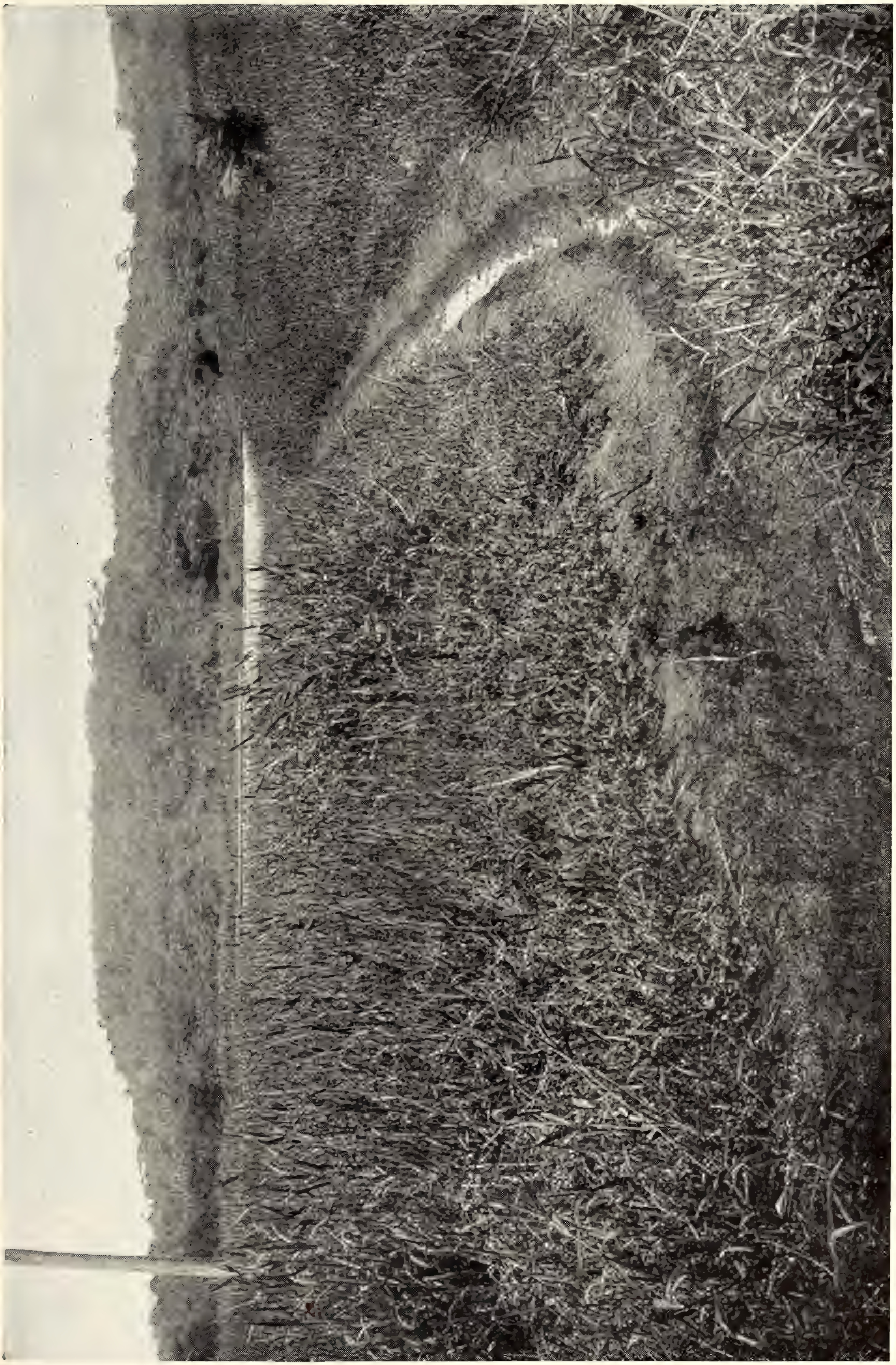
100 000-GALLON REINFORCED CONCRETE RESERVOIR, BUILT ON NAOS ISLAND FOR THE CULEBRA ISLAND QUARANTINE STATION AT A COST OF $5,064: 1910



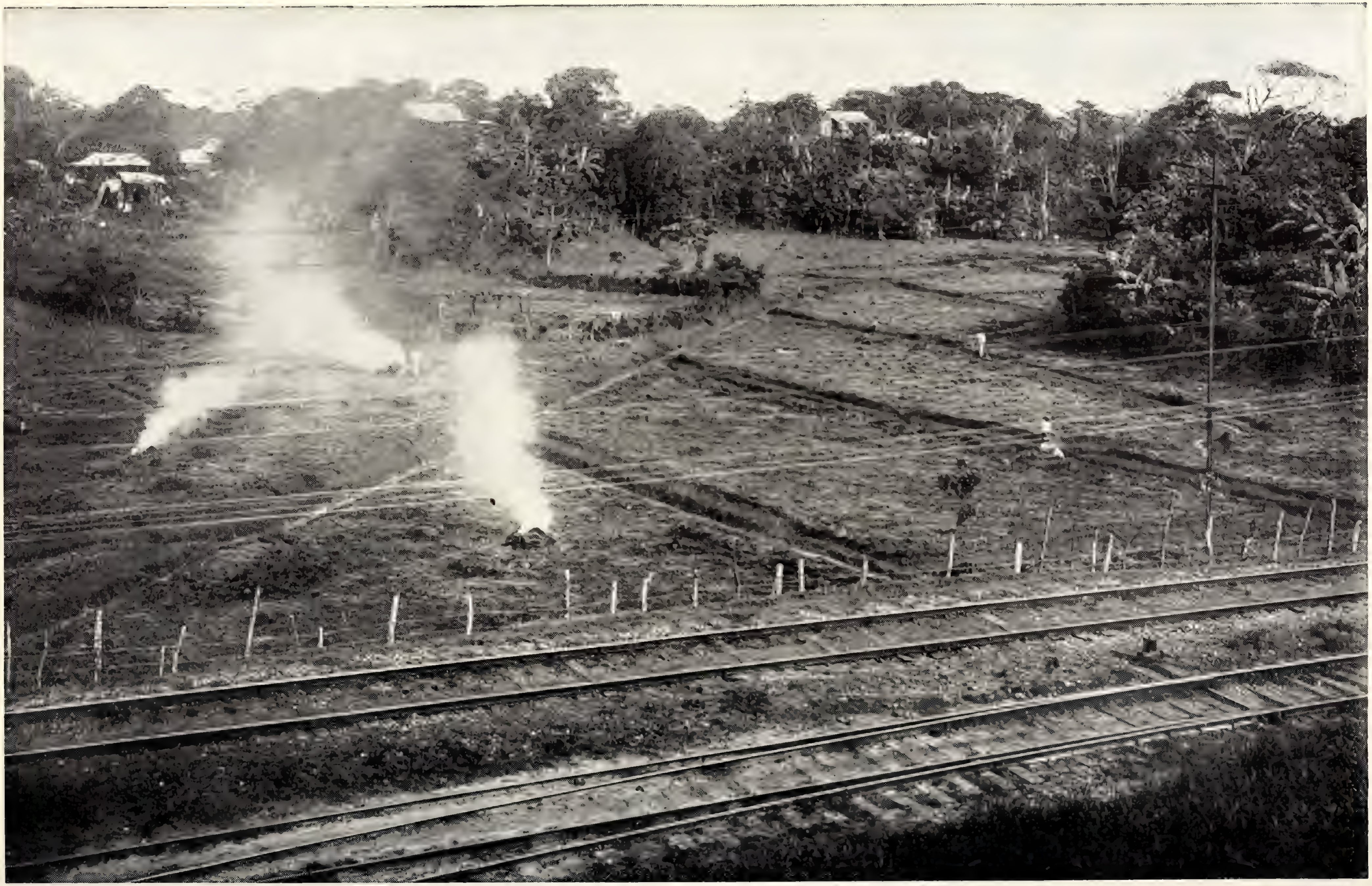
SPRAYING CRUDE OIL IN DITCHES TO EXTERMINATE THE MOSQUITOES

The sanitary department spent $43,000 last year for the purchase of oil and to pay laborers to distribute it

DITCH CLEANED BY HAND LABOR, SHOWING CONDITION TWO MONTHS AFTER CLEANING



CONDITION OF DITCH TWO MONTHS AFTER GRASS-BURNING



SWAMP NO. 4, MOUNT HOPE, NEAR COLON, SHOWING THE ARRANGEMENT OF OPEN-EARTH DRAINS USED FOR SWAMPY AREAS

The sanitary department expended $88,500 in 1910 for maintaining existing ditches and to construct new ones, $127,923.28 in grass and brush cutting, and $72,424 for the removal of night soil and garbage same method, the only difference being in the character of machinery used. The width of the channel adopted by the French was 74 feet; the present plan is for a channel 300 feet at the bottom, so that the first work undertaken by the Americans was directed to securing the necessary widths for the upper reaches before attempting any increase in depth.

Whatever water entered from rains and seepage was drained from the summit of the cutting by gravity to the Rio Grande on the south and to the Chagres River on the north. As shovels in excess of those required for widening became available, they were put to work to secure increased depth, care being taken to maintain, as far as possible, free, easy, and rapid drainage. Shovels are started at either end and carried towards each other, cutting out at a new summit. These pioneer shovels on the next lower grade make the "pilot cuts," which constitute the new drains and to which water is led by laterals from various parts of the excavated area adjacent. The average grade or slope is about 36 feet per mile. The loading tracks for these shovels are on the level above.

When the "pilot cut" has progressed sufficiently far, its cut or trench becomes the loading track for a second shovel, which is started to widen out the cut already made by the pioneer, and so the work moves forward, the shovels approaching the summit from either direction in echelon.

In 1904 the summit of the excavation was at Gold Hill and at reference 193 above sea level. The summit at present is between Empire and Culebra and is at reference 106 above sea level. The drainage to the south is still by gravity, through the old bed of the Rio Grande to the west of the Pedro Miguel locks. It is expected that before the next wet season the center culvert of the locks will be utilized.

On the north side conditions are now different. The reference of the low-water surface of the Chagres is 43 at the point of its intersection with the center line of the canal. The bottom of the completed canal is at reference 40. A dike separates the cut from the Chagres, but this is overtopped during the high floods. To get rid of the accumulated flood water, 24-inch pipes are laid through the dike, each with a suitable valve, and so arranged that all water above the pipes is carried into the Chagres by gravity after the subsidence of any flood.

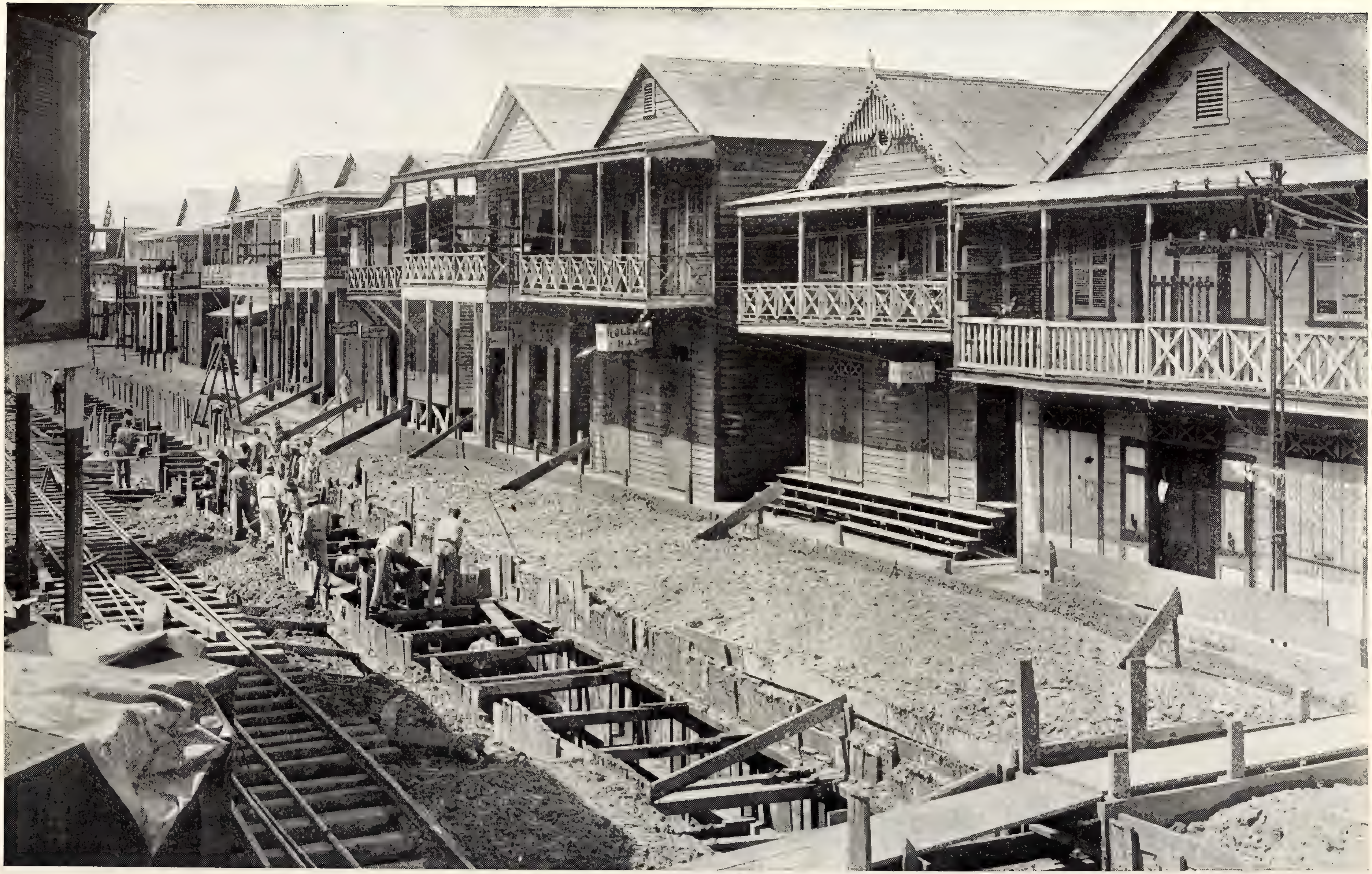
Recourse must be had to pumping whatever water remains from the floods below this level, and such as may be collected by drainage from the south; for this purpose a sump has been dug to elevation 32 and pumps installed. It is not possible to estimate the quantity of water that will have to be handled, but three pumps are in place, each capable of discharging 12,000 gallons of water per minute.

VERY TROUBLESOME SLIDES

The greatest difficulty encountered in the excavation is due to slides and breaks, which cause large masses of material to slide or move into the excavated area, closing off the drainage, upsetting steam shovels, and tearing up the tracks. The term "slide" is applied to the movement of the overlying clay upon smooth, sloping surfaces of rock or other material harder than the clay.

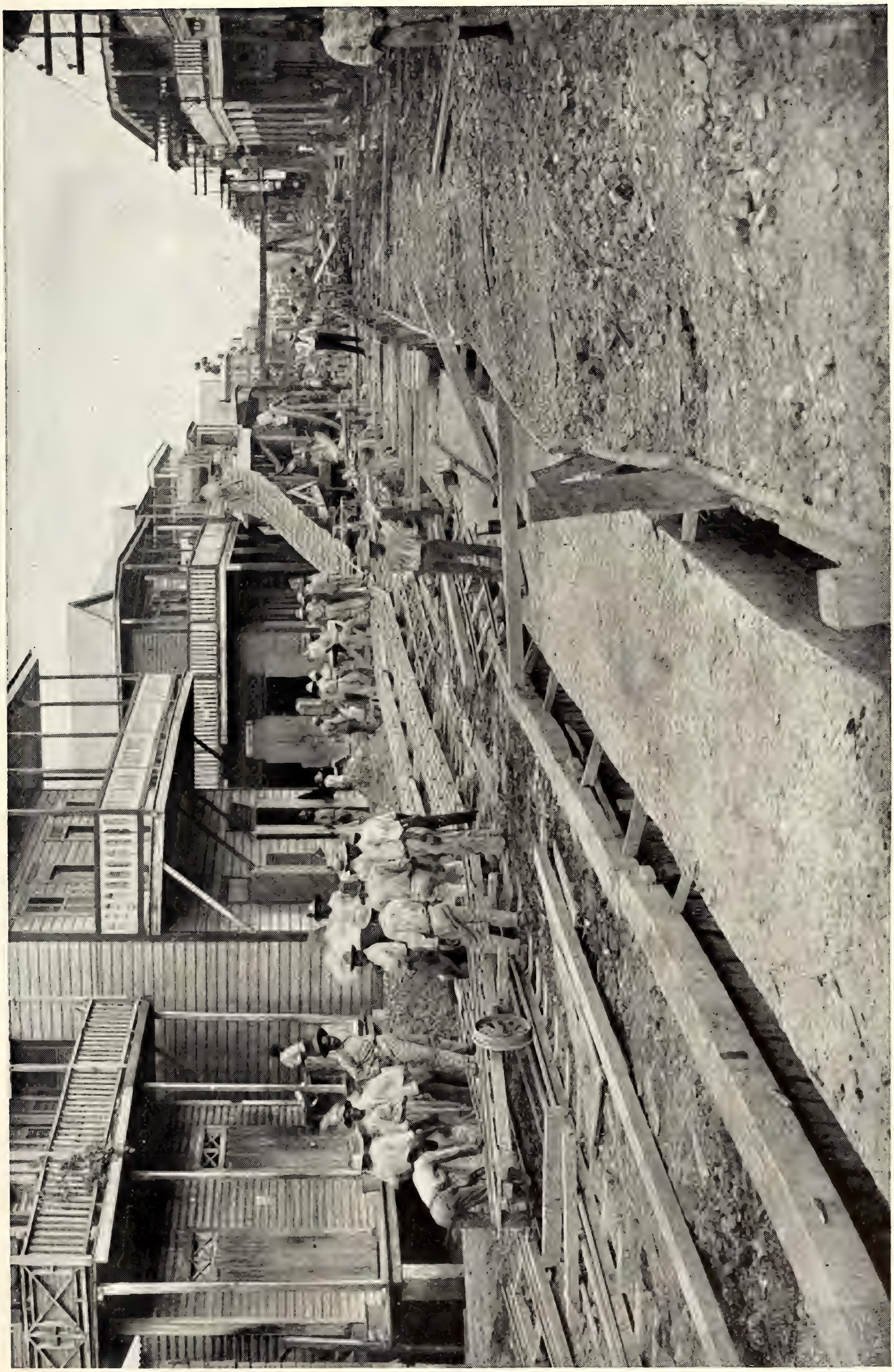
"Breaks" occur at points where the underlying rock is of poor quality, intersected by vertical seams or seams sloping toward the canal, and which is unable to bear up the superimposed mass. Generally, the upper surface of the broken portion of the bank remains approximately horizontal, settling nearly vertically. The weight of the broken portion forces up and displaces laterally the material lying directly below it in the bottom or on the berms of the canal. As the material thus forced up is taken away the upper part gradually settles and moves toward the axis of the canal until the entire broken portion is removed.

The greatest slide is at Cucaracha, and gave trouble when the French first began cutting, in 1884, and still continues.



METHOD OF EXCAVATION FOR STORM SEWER, "D" STREET, COLON, JULY, 1910

Before the Americans assumed control of the canal there were no sewers and no water system in the Zone. Panama, Colon, and all the towns along the line of the canal have since been provided with excellent water, and sewers for the principal sections have been constructed.

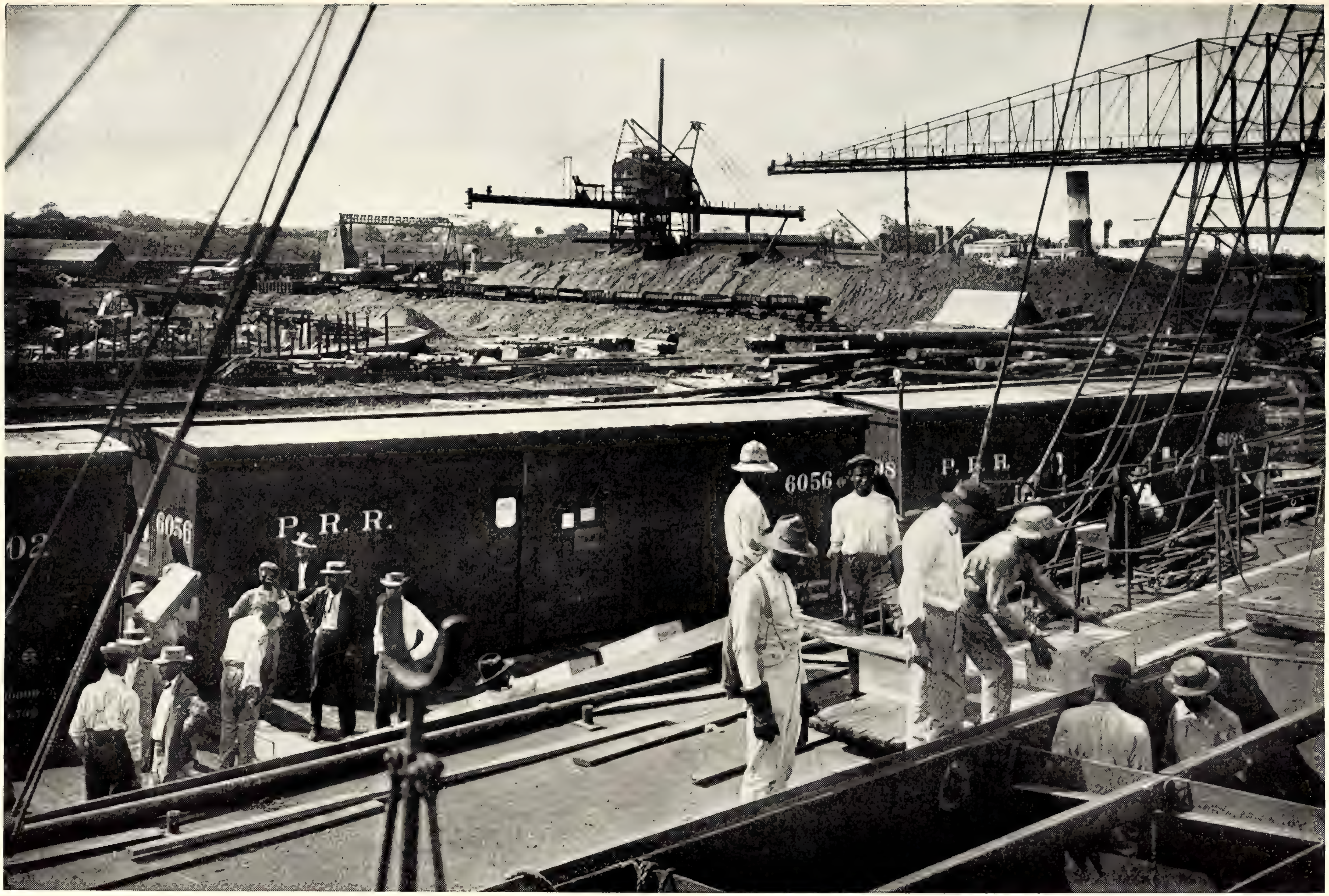


A NEARLY COMPLETED SECTION OF THE STORM SEWER IN "D" STREET, COLON, JULY, 1910

The lower half of the sewer is round and the upper half square

COLON HOSPITAL GROUNDS, NURSES' HALL, AND QUARTERS FOR PHYSICIANS

As the result of the care of the sanitary department, the health of the workmen is steadily improving. The daily average of sick in 1910 was 23.01 out of every thousand employed, compared to 23.49 for 1909, and 23.85 for 1908. The number of deaths among employees was 548, equivalent to an average of 10.84 per thousand, which would compare very favorably with the death rate of a similar class of people anywhere in the Temperate Zone. No cases of plague or yellow fever originated on the Isthmus. The deaths from typhoid fever among employees were only sixteen, one of whom was white and fifteen black, a remarkable record.



UNLOADING DYNAMITE FROM SHIP AT PIER 13, MOUNT HOPE, CANAL ZONE: 1910

Last year 14,742,400 pounds of dynamite and blasting powder were shipped to the Isthmus for work on the canal (see page 173); 350,000 tons of material, valued at $10,103,552.34, were received from the United States during 1910. The value of local purchases, including coal and oil, was $2,094,131.02—345,185 tons of coal and 465,921 barrels of fuel oil were used.

QUARTERMASTER'S CORRAL AT ANCON, BUILT IN 1910

This is the largest corral on the Isthmus; 600 horses, ponies, and mules are owned by the department

Though at first confined to a length of 800 feet, measured along the line of excavation, the slide has extended to include the entire basin south of Gold Hill or for a length of about 3,000 feet. The original slide covered an area of about six acres, but the latest surveys show that is has extended to cover 47 acres.

NO DANGER FROM SLIDES AFTER CANAL IS COMPLETED

There are all told nine "slides" and "breaks" to be reckoned with, and there is nothing to do but to remove all the material embraced within their limits. As the cut is deepened these may be aggravated or others may develop. There is no method known to stop or to prevent them. Usually the first indication received, if there be a forewarning, is the lifting or moving of a shovel and tracks.

The cut has therefore developed into the uncertain and experimental feature of the work and its completion will mark the date of finishing the canal. No apprehension is felt because of the slides after the completion of the work. They develop as the depth of the cut increases, and the banks slide or break because of the condition of unstable equilibrium that results from the cutting; when grade is reached equilibrium will be established, and the back pressure of the water will result in greater stability. Whatever slides occur subsequently will be relatively small, and the material can be easily handled by steam shovels on the berms that will be left and by dredges that will be available.

Some idea of the magnitude of the slides can be obtained from the fact that during the fiscal year 1909, of 14,325,876 cubic yards removed, 884,530 cubic yards, or 6 per cent, were from slides. For the fiscal year 1910, of 14,921,750 cubic yards that were removed, 2,649,000, or 18 per cent, were from slides or breaks that had previously existed or that had developed during the year.

THE MATERIAL IS ALL ROCK

Except for the slides, which are of earth, the material to be removed is rock, and requires blasting to enable the shovels to handle it expeditiously. The largest part of the drilling is done by churn or well drills, though tripod drills replace them where the others cannot be used to advantage. The drills are operated by compressed air, supplied by three compressor plants, which are connected together by a 10-inch pipe line about five miles long, with 6-inch and 4-inch leads running into the cut. The drills operate in batteries of from 4 to 12; the holes, from 15 to 27 feet in depth, are spaced from 6 to 16 feet apart.

The explosive used is dynamite, 45 per cent to 60 per cent nitro-glycerine. Excessive moisture and water in the holes prevent the use of blasting powder. When the holes in any section are ready for blasting, they are "sprung"—that is, four to six sticks of dynamite are lowered to the bottom and exploded—thereby forming a chamber for the reception of the charge. The charges vary from 25 to 200 pounds, depending upon the local conditions; the tamping follows, and the explosion is effected by an electric current from one of the lighting plants.

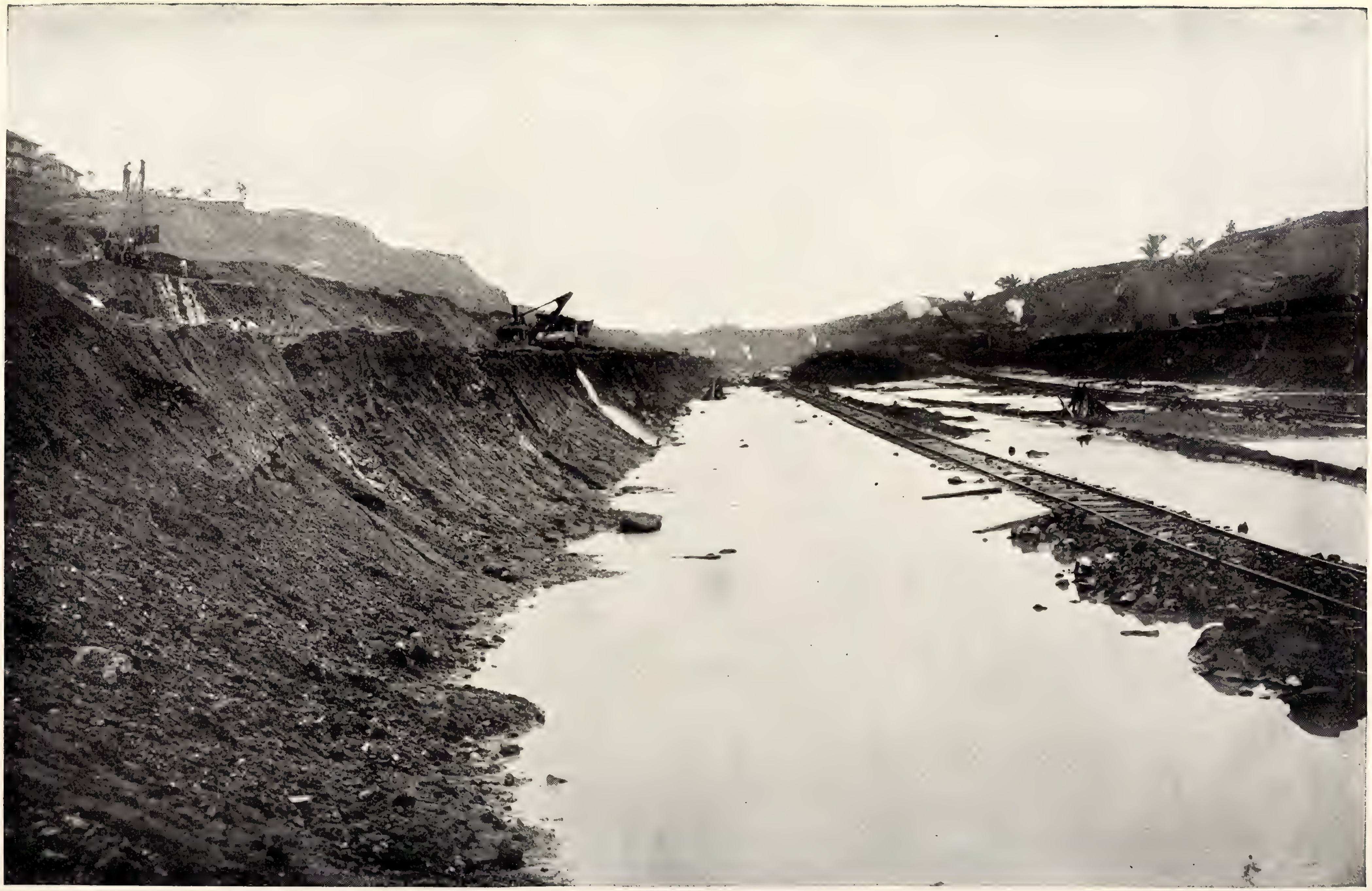
THE EARTH AND ROCK FROM THE CULEBRA CUT ARE USED FOR THE BREAKWATERS AND EMBANKMENTS

Through the blasted area the steam shovel cuts its way, averaging 34 feet wide at the bottom and 50 feet at the top for the "pilot cuts," which are 8 to 12 feet deep. The widening cuts are about 26 feet wide and from 15 to 24 feet deep.

The best results are secured with the 95-ton shovels, though the 45-ton and 70-ton shovels are also used. The 95-ton shovels have dippers of four and five yard capacities, the former removing rocks containing as much as six cubic yards.

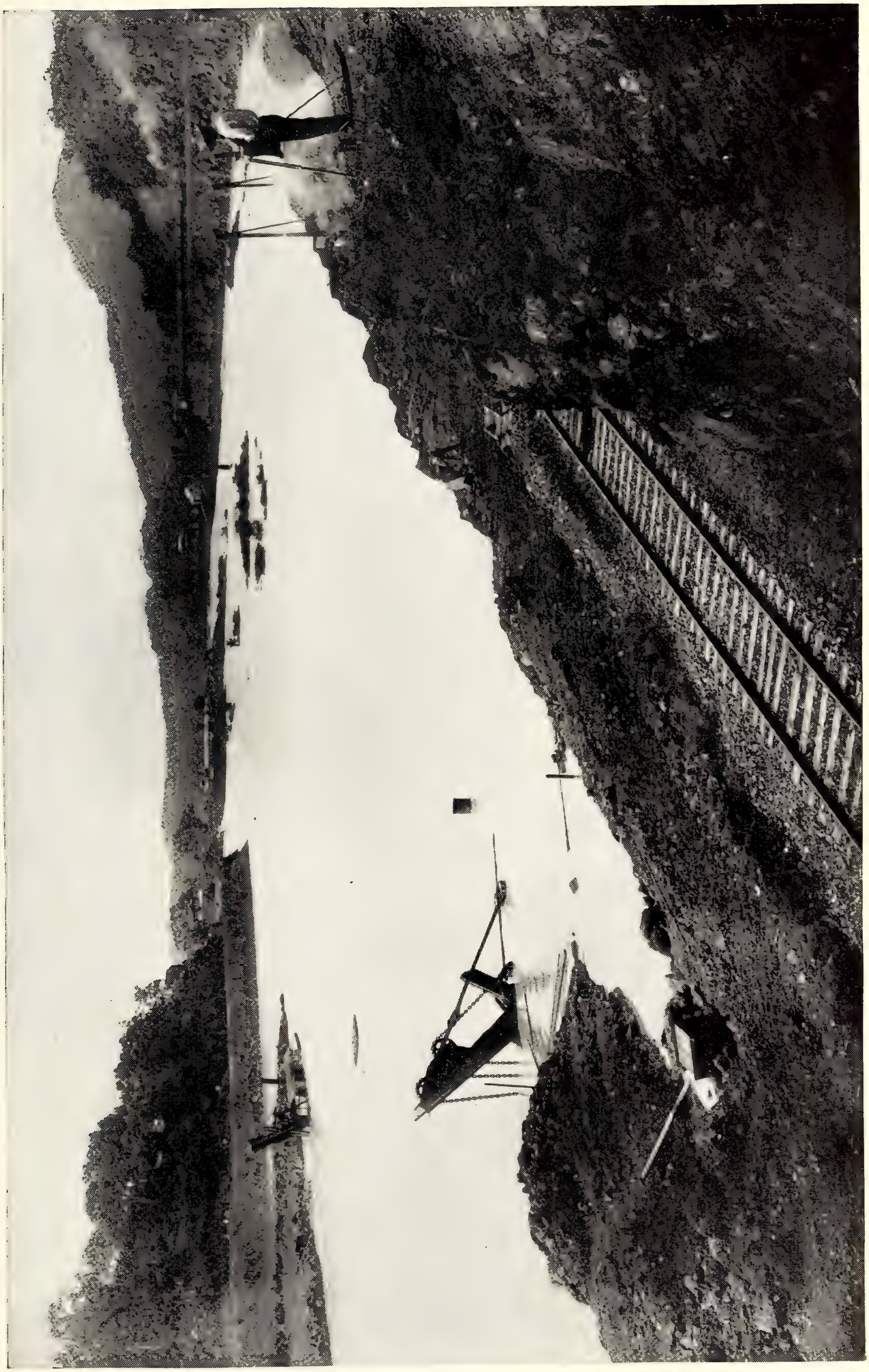
When the rocks are too large to be lifted by the shovel, they are "dobie" blasted, and thus broken to sizes convenient for the dipper. This is done by placing three or more sticks of dynamite on the rock, covering them with mud and igniting by means of a slow match.

The shovels load the material on dirt trains, consisting of 20 flat cars and

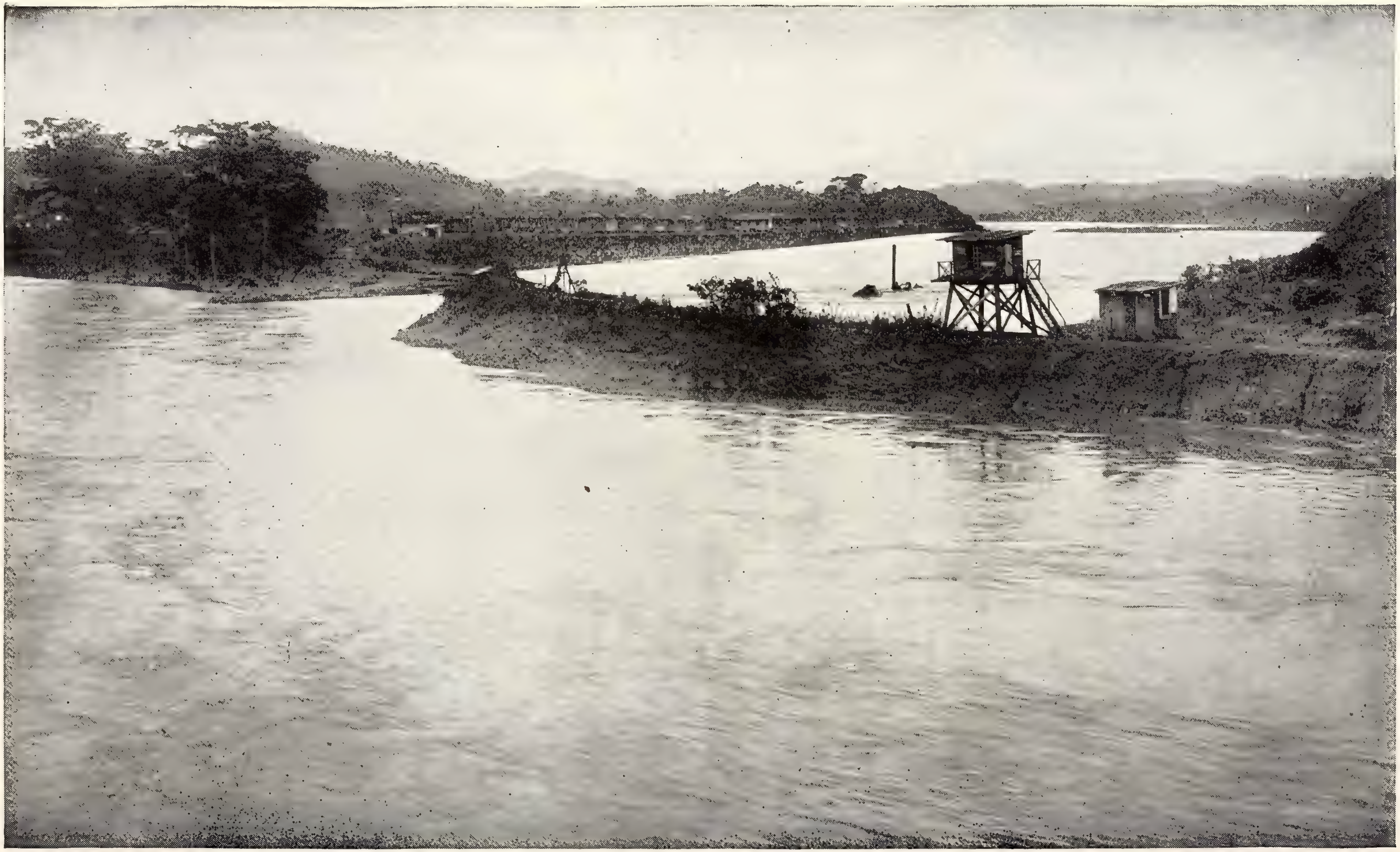


CULEBRA CUT, OPPOSITE TOWN OF CULEBRA, LOOKING NORTH, JUNE 10, 1910, AFTER A HEAVY RAIN OF ONE HOUR

There is a record of 5.86 inches of rainfall in one hour



STEAM SHOVELS SUBMERGED IN THE CUT AT BAS OBISPO DURING A FLOOD (SEE PAGE 180)



THE CHAGRES RIVER BREAKING THROUGH A PROTECTION DIKE AND FLOODING THE CANAL (SEE PAGE 167)

The Chagres River has been known to rise 25.6 feet in 24 hours from 25 to 35 steel side dumps to a train. The available dump grounds in the vicinity of the cut were utilized to their fullest capacity by the French and during the earlier periods of American control, so that longer hauls are necessary.

The new line of the Panama Railroad, being above the lake level, requires many heavy embankments, which offer suitable places for depositing material. The breakwater from Balboa to Naos Island offers a dump, though requiring an average haul of 11 miles.

As difficulty is experienced in extending this breakwater, additional dump tracks are provided at Balboa, so as not to delay the trains, and land at the inner end of the breakwater is being reclaimed; already 253 acres have been filled in. The interior swamps in the vicinity of Ancon are also to be filled. From 16 to 22 trains of material are sent daily to Gatun, an average haul of 25 miles, and used in building up the toes of the dam or for large rock to place in the concrete. The remainder of the excavated material is wasted on extensive dumps at Miraflores. A large dump ground at Tabernilla was used, but is abandoned for the present.

The Lidgerwood flats are dumped at Miraflores, Balboa, and on the relocated line of the Panama Railroad, where special equipment is kept to handle them, consisting of plows, unloaders, spreaders, and track-shifters. The plow is attached to one end of the train, and the unloader, consisting of a steam-driven drum on which is wound the cable, at the other end. To stretch the cable, the train passes between two uprights to which the cable is attached temporarily, and by moving the train the cable is drawn from the drum to the plow to which the end of the cable is attached. Winding the cable on the drum draws the plow the length of the train, removing the load.

After the material is plowed off, the spreader performs its functions, and, when no longer capable of throwing the material beyond the edge of the dump, the track is shifted by a device patented by W. G. Bierd, formerly general manager of the Panama Railroad, which raises by one motion the track with the ties so as to clear the ground, and by another motion pulls it sidewise. The usual throw is two and a half to three feet, though, if the rails will permit, the track can be thrown as much as nine feet in one throw (see page 179).

The steel dump-cars require no special or extra appliance for their operation, and can be dumped as easily on curved as on straight track. They also dump to either side.

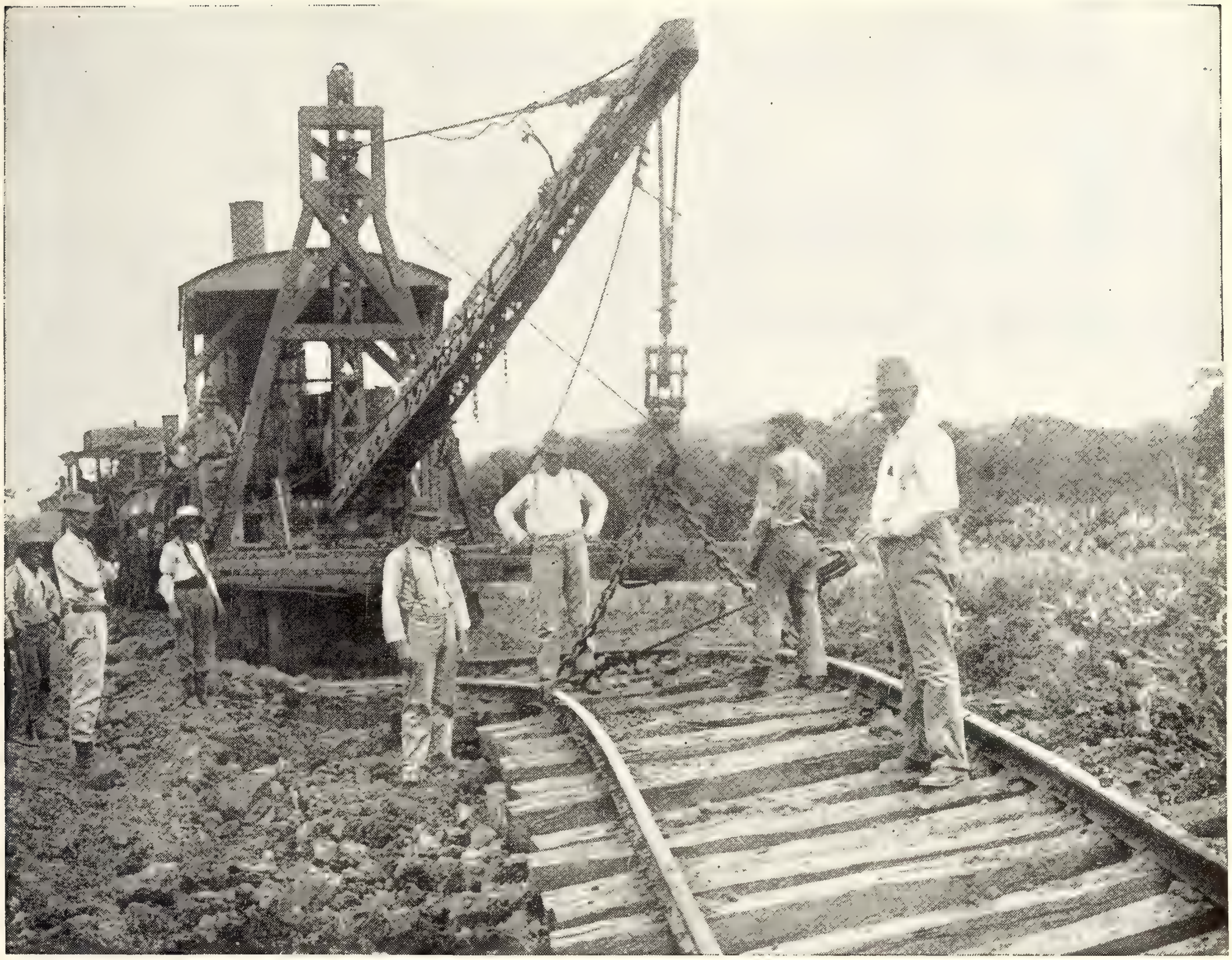
Work has been in progress on the Culebra Cut since 1880, and during the French control 18,646,000 cubic yards were removed. Between Gatun and Bas Obispo, the northern end of Culebra Cut, the French excavation which is useful to the present project amounted to 2,201,000 cubic yards, or a total in the Central Division of over 20,000,000 cubic yards. The total estimated amount of material to be excavated from May 4, 1904, in this division was 97,125,018 cubic yards, of which, up to January 1, 1911, 67,792,855 cubic yards have been removed, or 69.7 per cent. It is expected that all the excavation in the lake section will be finished by July 1, 1911.

Some idea of the magnitude of the operations may be formed from the fact that this division has within its jurisdiction over 200 miles of 5-foot-gauge track laid, about 55 miles of which are within the side slopes of the Culebra Cut alone.

THE GREAT DAM AT GATUN IS A VERITABLE HILL

An earth dam across the Chagres at Gatun impounds the water of the river and creates the lake which constitutes the summit level. The dam is 7,500 feet long over all, measured along the top, and, according to the latest profile, it is 2,100 feet wide at the base, 398 feet through at the water surface, reference 85, and 100 feet wide at the top, which is 115 feet above sea-level. It crosses two valleys separated by a hill rising to elevation 110, in which the regulating works are being constructed. Of the total length of the dam, only 500 feet

DEPOSITS OF SAND AND GRAVEL BROUGHT DOWN BY HIGH FLOODS OF THE CHAGRES RIVER IN NOVEMBER AND DECEMBER, 1909



TRACK-RAISING AND SHIFTING MACHINE

This powerful machine lifts the track and ties clear of the ground and then deposits them from three to nine feet away. It bends the steel rails as easily as if they were made of clay (see page 177).

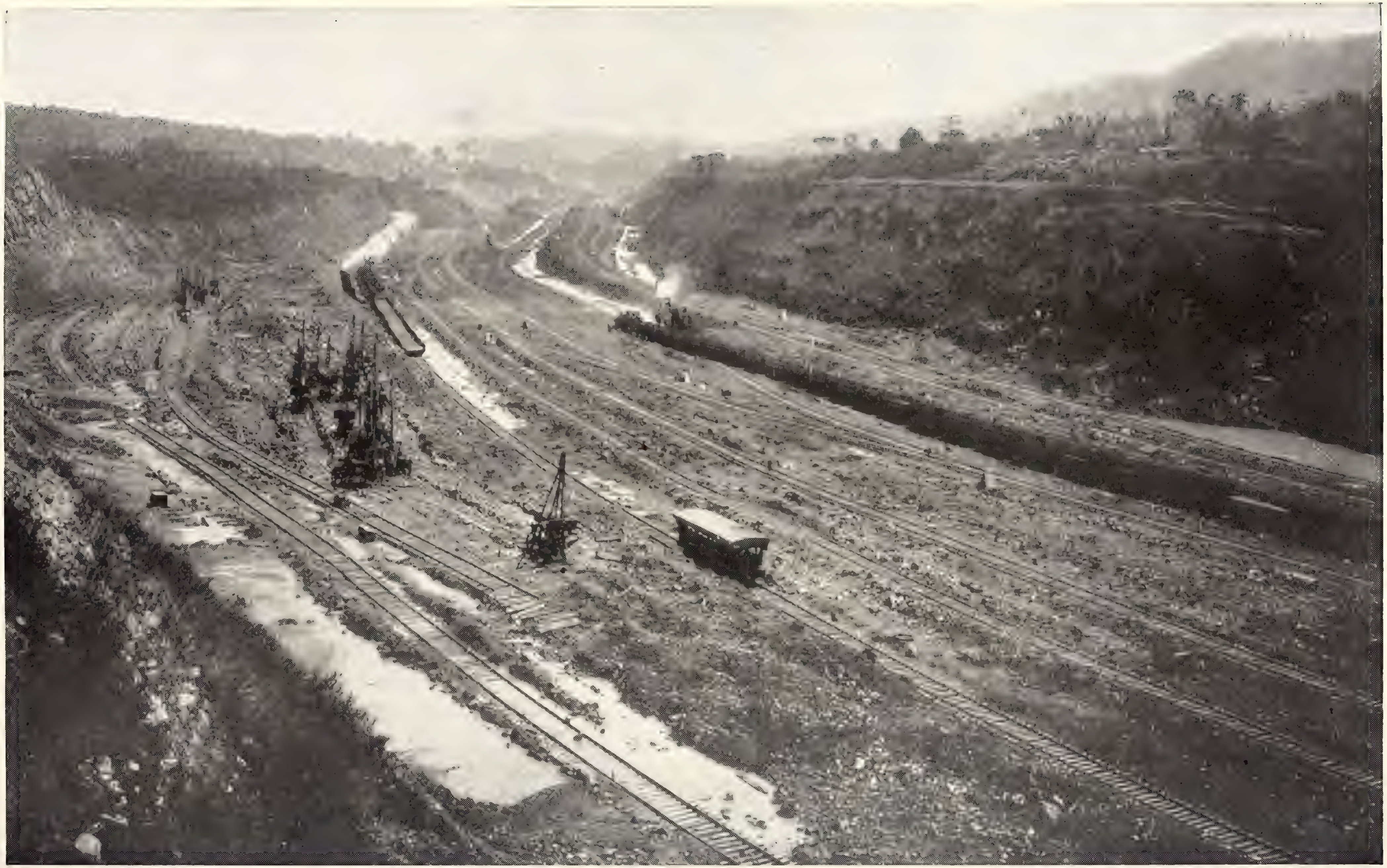
will be exposed to the maximum head of 85 feet, the remainder to less.

The dimensions of the dam have been criticised as excessive and unwarranted, but its designers considered it desirable, in view of the amount of material available, that ample provisions be made against every force which may affect its safety, and that a barrier be made so that the layman without engineering knowledge would recognize its stability. Now that the dam is assuming appreciable proportions, this latter object is more than realized.

The dam in plan is a broken line to conform to the configurations of the natural surface, thereby materially reducing the fill. It extends from the hill in which the locks are to be constructed to Spillway Hill, thence along the spur or hog-back of the hill on the west side of the valley (see map, page 201).

The adoption of the earth dam brought on such criticism that an exhaustive examination of the foundations was made in order to determine more carefully the character and extent of the various underlying materials; to ascertain whether there was any possible connection between the swamp areas to the north and south through the deposits in the gorges across which the dam will be built; for testing the ability of the material to support the proposed structures, and for learning whether suitable material for the dam could be obtained in the immediate vicinity.

As the result of the investigations, it



CUT AT EMPIRE, LOOKING NORTH

In the upper right-hand corner is seen the break in the rock bank which let the Obispo diversion into the canal for three days, drowning out some of the shovels at the north end. This break aggregates about 40,000 cubic yards, but will not be disturbed until the dry season. A flume has been constructed of timber and concrete to carry the flow of the diversion past the break (see page 175).

may be briefly stated that the underlying material is impervious to water; that it possesses ample strength to uphold the structure that will be placed upon it, and, the subsoil being impervious, that there is no connection between the swamps above and the sea below.

Because of the sluggish current of the river in the vicinity of Gatun and above, the deposits consist of the finer sands and silts interspersed with beds of clay. By constructing experimental dams of this material and subjecting them to the full head of water, it was conclusively demonstrated that this material is suitable for the interior or the impervious core.

The dam is constructed by forming two dumps on the outer lines of the structure and depositing waste material, mostly rock, obtained from Culebra, the lock site, and Mindi. The area between the piles thus formed is filled with the material pumped in by hydraulic dredges, the natural surface of the ground having been previously cleared of vegetation and a suitable bonding trench excavated.

THE SPILLWAY

Fluctuations in the lake due to floods are to be controlled by regulating works constructed in Spillway Hill. Objections were made to constructing such works in the line of the dam, but because of the natural configuration of the ground, irrespective of the location of the spillway, provision had to be made for tying the dam to the sides of the hill; moreover, the extent and elevation of the hill, as well as the material composing it, make it a suitable and desirable place for the waste weirs. The channel has been cut, the floor and side walls of concrete completed, and the Chagres River now discharges through it. As the reference of the floor is at 10 feet above sea-level, the lake is already formed at least to this height.

The spillway dam will be of concrete with its crest at elevation 69. Piers 8.5 feet wide will be built on top of the crest, 53.5 feet centers, grooved for Stoney gates, which will close the openings and complete this portion of the dam. The trace of the dam will be the arc of a circle 740 feet long, with 14 openings, which, when the gates are raised to the full height, will permit a discharge of 140,000 cubic feet per second. The water discharged over the dam will pass through a diversion channel into the old bed of the Chagres. (See map, page 201.)

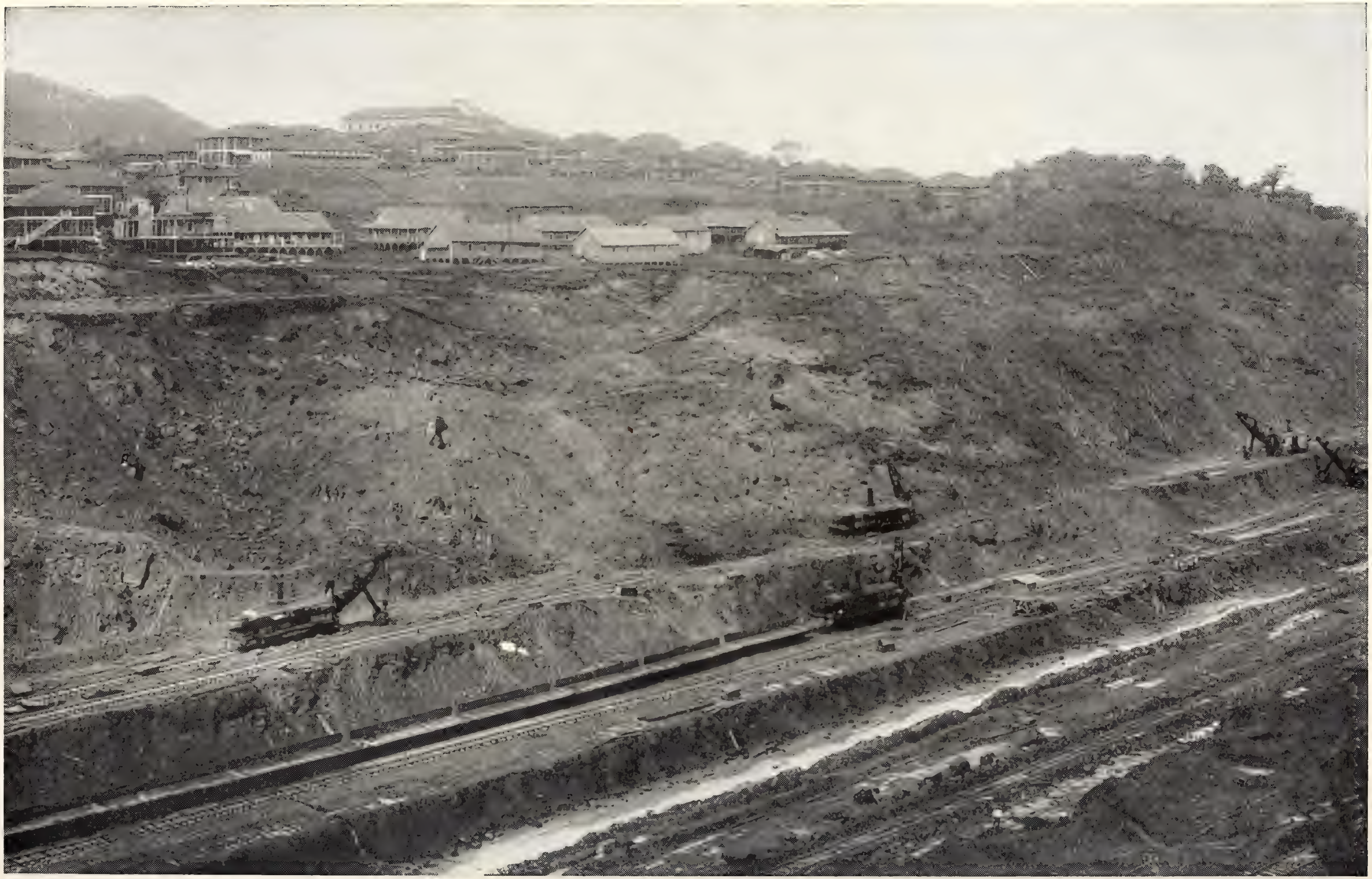
The dam is to contain 21,145,931 cubic yards of material. On January 1, 1911, there had been placed 12,001,592 cubic yards, making 56.72 per cent of the dam complete. The spillway will contain an estimated quantity of 225,485 cubic yards of concrete, of which 113,269 cubic yards, or 50.23 per cent, were completed on January 1.

THE LOCKS CAN BE FILLED OR EMPTIED IN 8 MINUTES

The locks are in pairs, so that if any lock is out of service navigation will not be interrupted. Thus, also, when all the locks are in use, the passage of shipping will be expedited by using one set of locks for the ascent and the other for descent. The locks are 110 feet wide and have usable lengths of 1,000 feet.

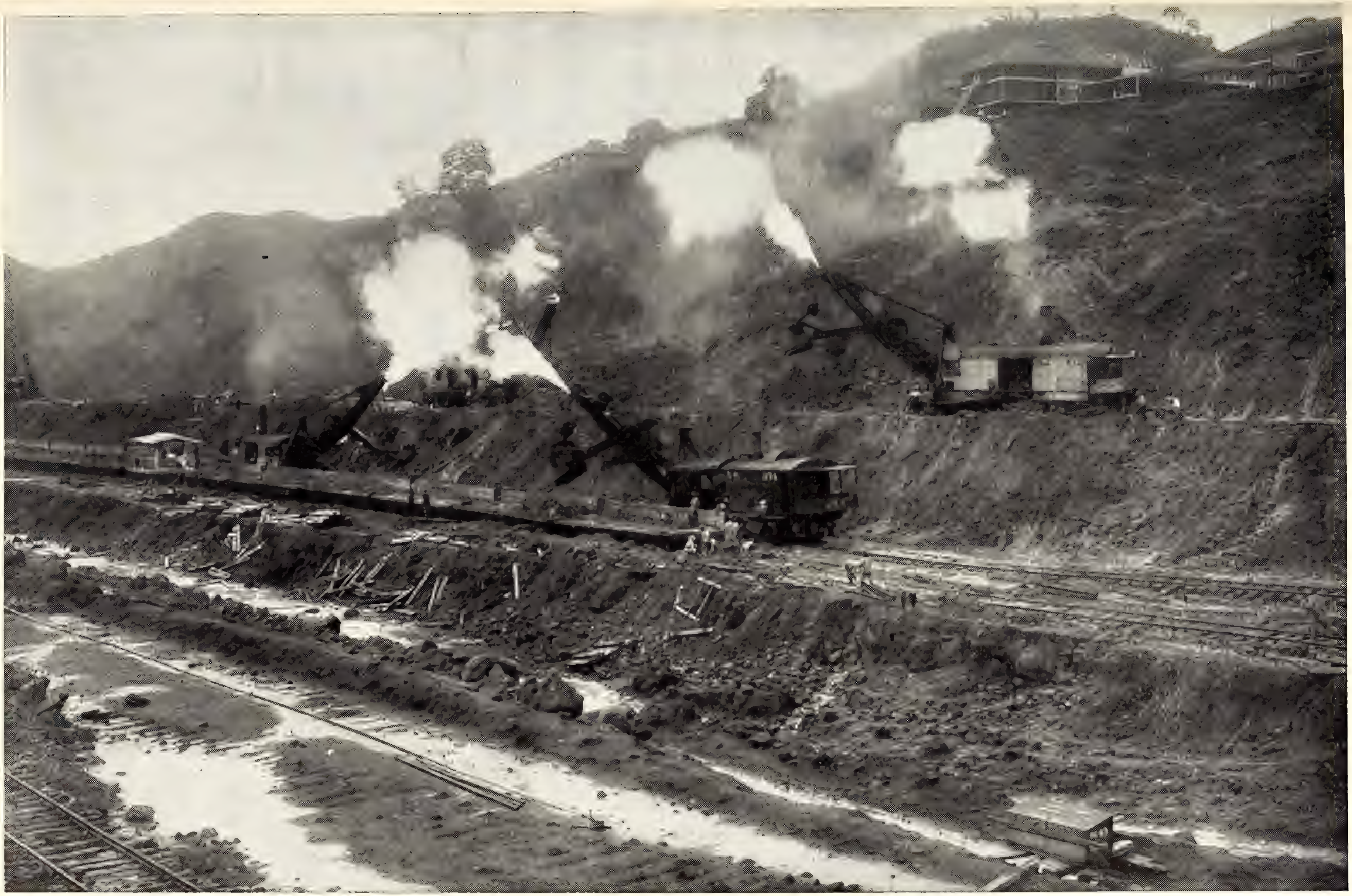
The system of filling adopted consists of a culvert in each side wall feeding laterals perpendicular to the axis of the lock, from which are openings upward into the lock chamber. This system distributes the water as evenly as possible over the entire horizontal area of the lock, and reduces the disturbance in the chamber when the latter is being filled or emptied. (See diagram, page 202, and illustrations, pages 206-207.)

The middle or separating wall contains a single culvert of the same area as the culverts in the side walls, which feeds in both directions through laterals controlled by valves designed to operate against a head from either direction. This arrangement permits communication between the chambers of twin locks, so that water may be passed from one lock to the other of the pair, effecting a saving of water. The main culverts are controlled by Stoney valves, and the lat-



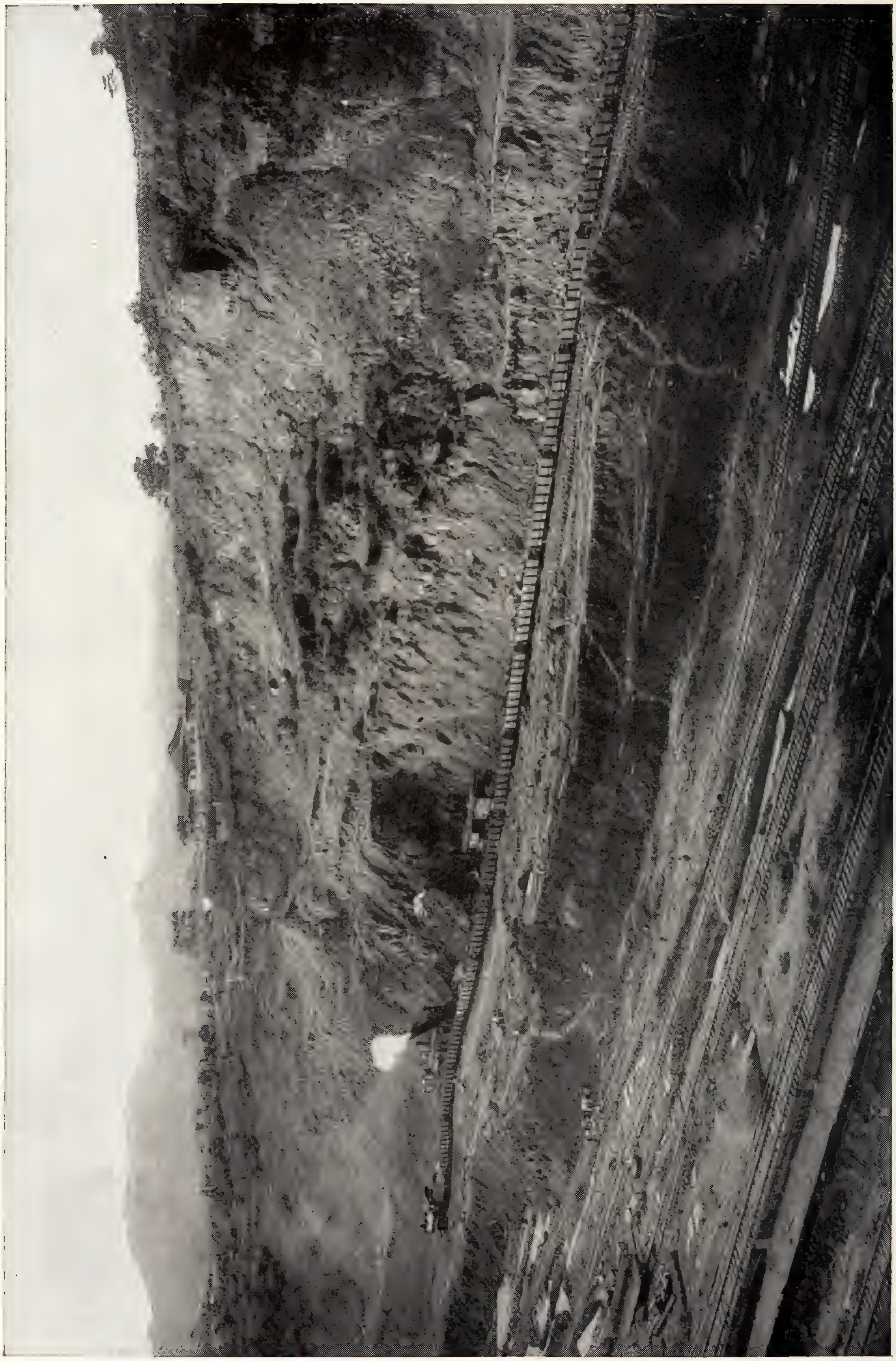
BREAK IN THE WEST BANK OF THE CANAL AT CULEBRA

Note the successive benches on which the shovels work (see page 167). Nearly one-fifth of all the material removed from Culebra Cut in 1910 was from slides and breaks like this

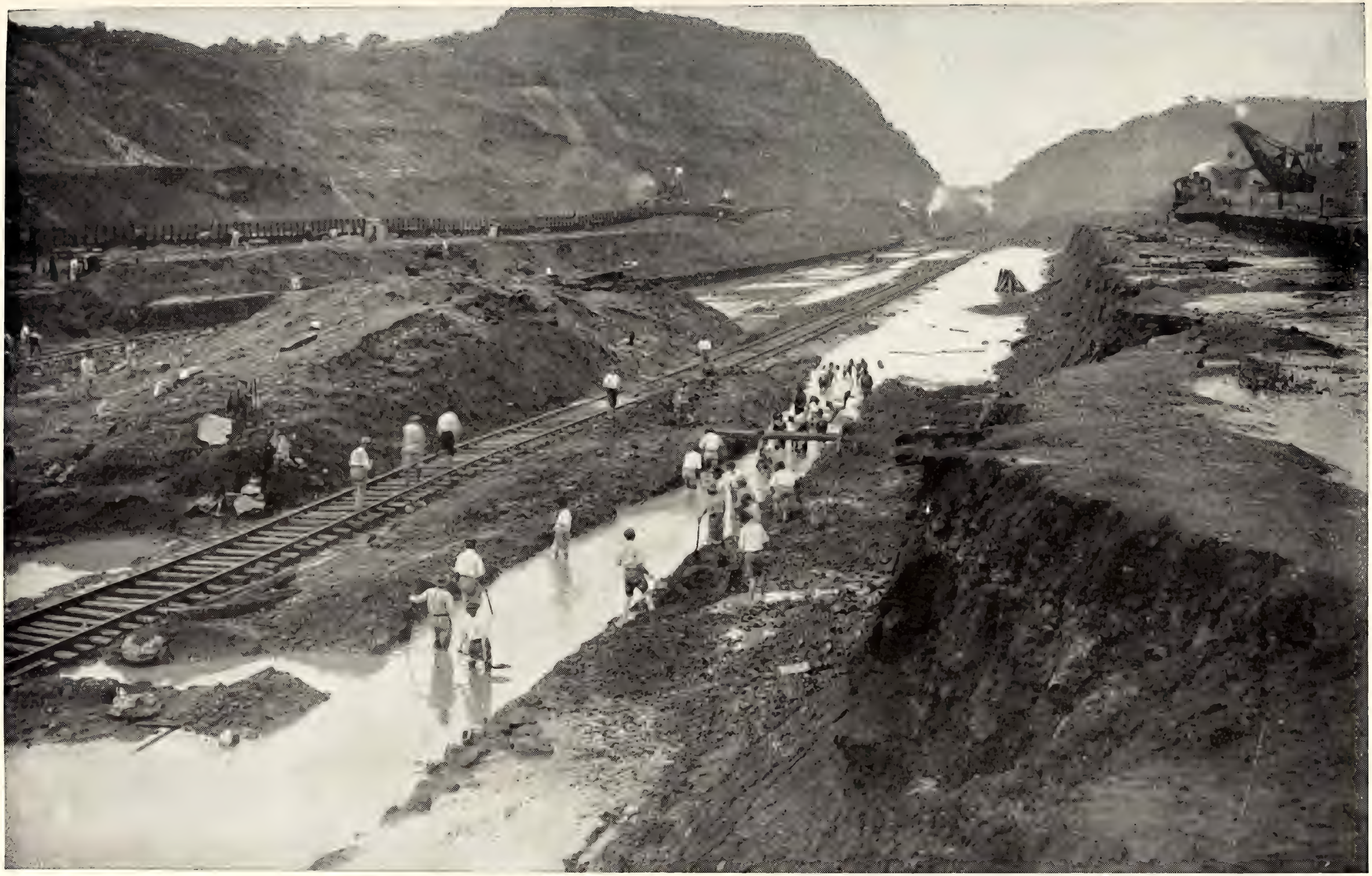


ANOTHER VIEW OF THE BREAK IN THE WEST BANK AT CULEBRA, SHOWING FOUR STEAM SHOVELS WORKING ON THE BROKEN AND MOVING MASS

The two upper shovels are casting material over the berm, to be loaded by the two lower shovels into the Lidgerwood train. This break has necessitated the removal of nearly 2,000,000 cubic yards



BREAK IN THE EAST BANK OF THE CANAL, OPPOSITE CULEBRA, JUNE, 1910



BREAK IN THE EAST BANK AT CULEBRA

Showing how the pressure of the broken bank, shown in the preceding picture, has raised the bottom, for a short distance, to a height of 18 feet above its original level (see pages 167 and 173). A similar break advanced 14 feet in 24 hours, overturning the steam shovels and disheartening the men. There is no way to prevent these breaks.

CULEBRA CUT, LOOKING NORTH

erals leading from the center wall by cylindrical valves.

Assuming a difference of head of 30 feet, it is estimated that the entire lock can be filled or emptied, using one culvert in 15 minutes and 42 seconds, and in 7 minutes and 51 seconds when both culverts are used.

The lock gates are of the mitering type, double leaf, straight gates, varying in height from 45 feet 7 inches to 79 feet; the length of each leaf is about 65 feet. A contract has been entered into for furnishing the steel for the gates and for their erection in place by June 1, 1913. To meet this condition, it is necessary that the concrete work shall be completed in time to enable the contractors to begin the erection of the various sets of gates on the dates specified in their contract, and the work is being prosecuted with this end in view. To accomplish the result, the concrete for the Gatun locks must be finished by June 1, 1912, and that for the locks on the Pacific side by October of the same year.

SAFETY DEVICES

It has been accepted as a fundamental feature of the design that at each flight of locks there must always be two barriers separating the high level from the level next below. To carry this out, two sets of mitering gates are placed at the upper and two at the lower end of each of the uppermost locks in each flight.

In addition a chain device is used to guard the barrier gates against accident, and so controlled as to be capable of checking a ship of 10,000 tons moving at the rate of about five miles an hour.

More than 95 per cent of the vessels navigating the high seas are less than 600 feet in length, and this has been taken as the determining factor for the location of intermediate gates, which are introduced in the design to save both time and water. For the protection of the intermediate gates against vessels using a smaller length of chamber a chain barrier is to be installed.

Guide piers are provided both upstream and down, to which vessels will tie before entering the locks. Designs for electric towing machines are being prepared, which will be used for towing vessels into and controlling their passage through the locks by means of lines or cables attached to what may be considered the four corners of the ship.

Even with all of these precautions accidents may happen, and emergency dams are provided at the head of each flight of locks, consisting of swing bridges, which can be thrown across the locks in case of an accident which makes a connection between the top level and the level below; wicket girders are let down from these swing bridges, supported by a sill at the bottom and the horizontal truss work of the bridge at the top. These wicket girders act as runways for gates, which are lowered and gradually stop the flow.

GATUN LAKE WILL STORE WATER FOR THE DRY SEASON

It will not be out of place at this point to give consideration in a general way to the question of adequacy of the water supply to maintain a large commerce through the locks. Data bearing on the subject have been collected for many years and studied with care. During eight or nine months of the year there is more than a sufficient supply for all purposes, but during the other four or three months there is practically none, and it becomes necessary to store a sufficient quantity during the rainy season to supply the needs during the dry season.

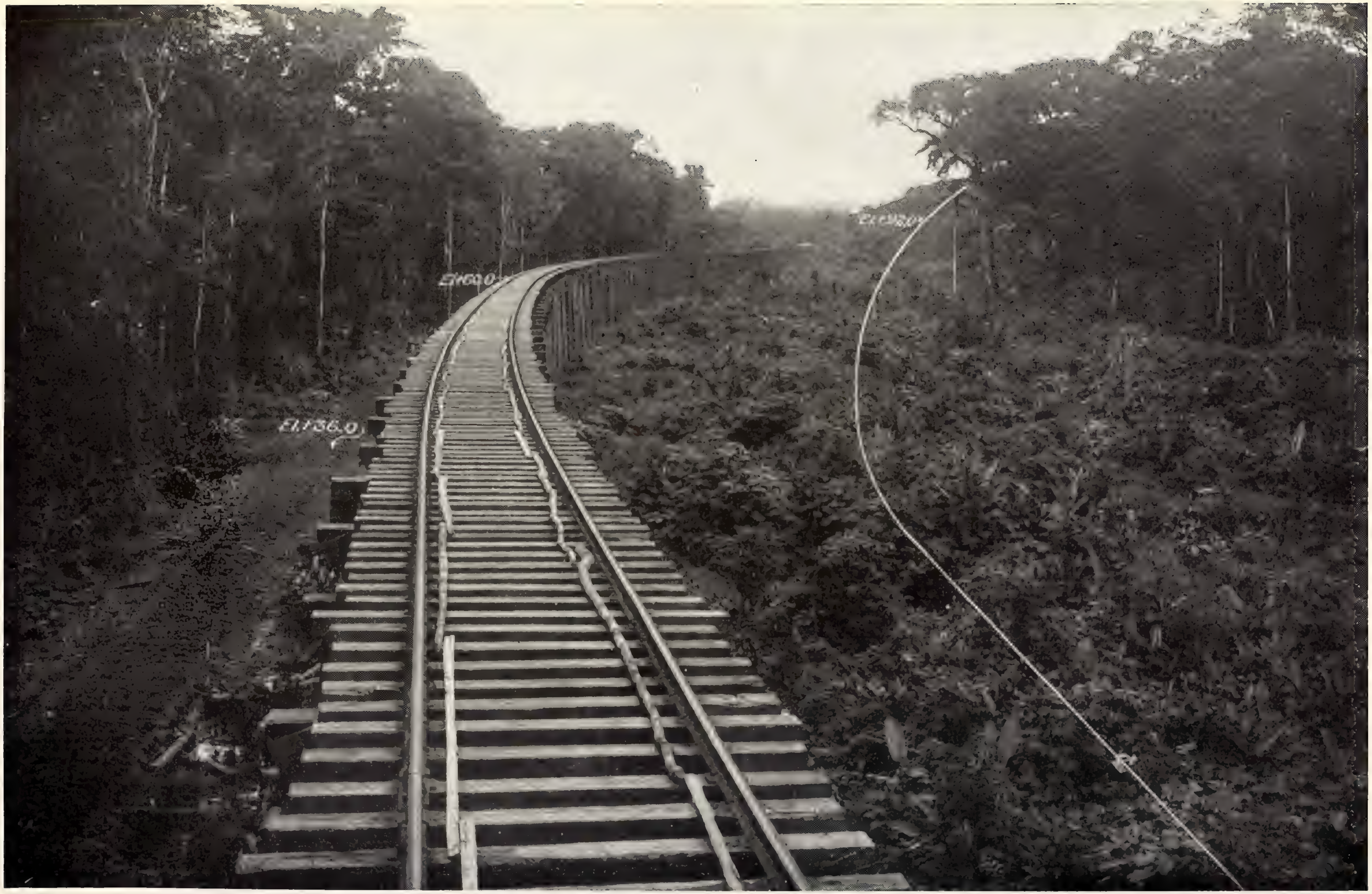
The enormous reservoir of Gatun Lake is available for this purpose. The bottom of the canal in the summit level is at reference 40, and it is evident that navigation, with the extreme depths provided of 40 feet in sea water, can be carried on until the surface of the lake falls to reference $81\frac{2}{3}$. As the water surface in the lake is to be allowed to rise to reference 87, there is stored available for the dry season a little more than five feet.

Making due allowances for power consumption, evaporation, about which data are available, seepage and leakage at the gates during a dry season of minimum flow, assumed as following a wet season of minimum flow, an average of 41 passages of the canal per day is possible, using the full length of lock. In the average dry season 58 complete transits of the canal are possible, or a greater number than the 24 hours of the day would permit, allowing vessels to follow each other at intervals of one hour.

With the design for the locks as adopted a certain amount of water can be saved at each lockage whenever a vessel does not draw the full permissible depth of 40 feet by cross-filling or emptying through the middle wall. As a consequence it can be stated that there will be sufficient water for as many lockages as the time in the day will permit.

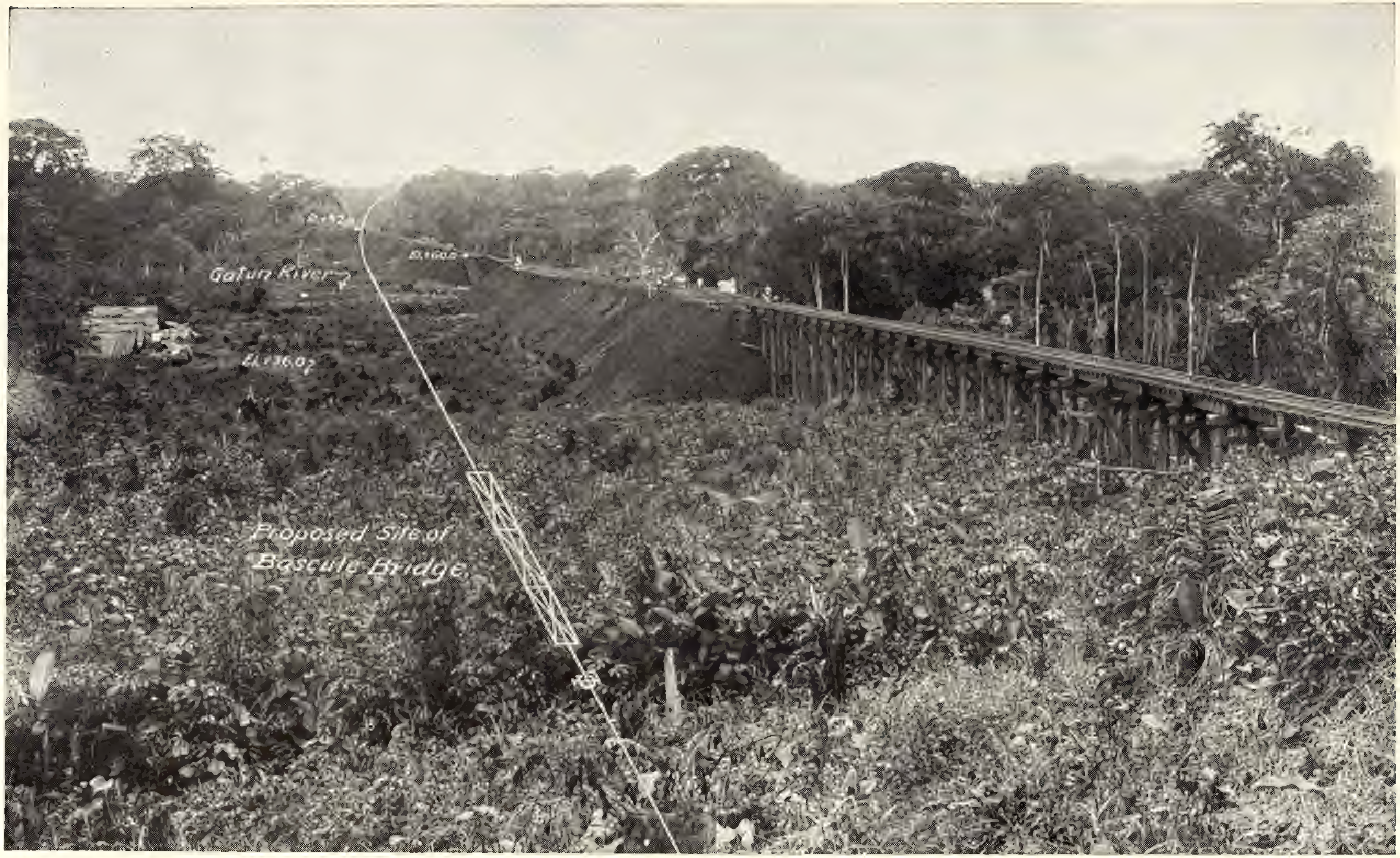
INGENIOUS METHODS FOR HANDLING THE ROCK AND CEMENT

At Gatun three locks in flight overcome the difference in level between the lake and sea, and are being constructed in a cutting made through a hill. The excavation, consisting of upwards of 5,000,000 cubic yards, mostly rock, is practically completed. The locks are of concrete, and contain about 2,046,100 cubic yards of this material. On January 1 last they were 49 per cent completed.

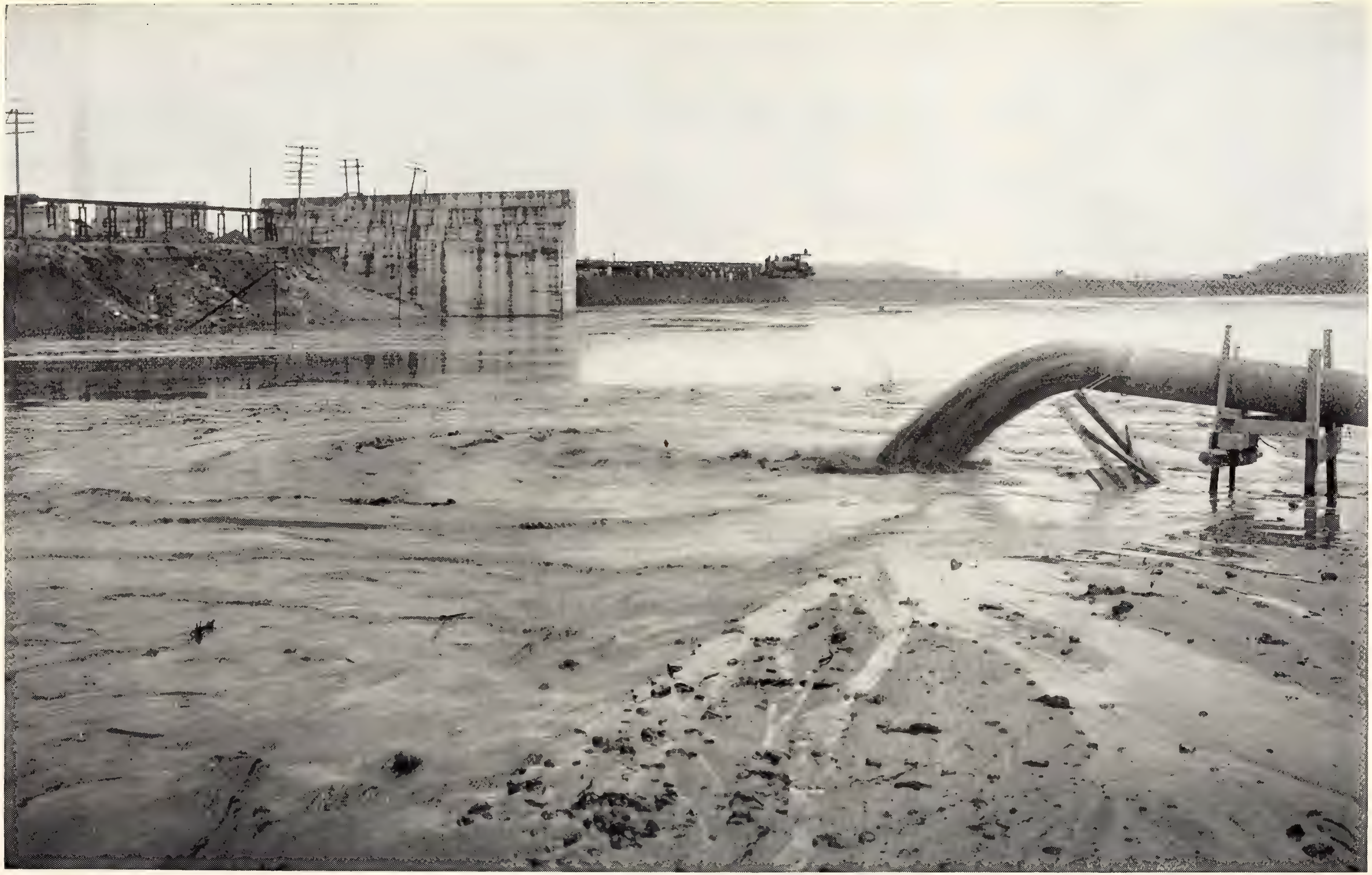


A TEMPORARY TRESTLE ACROSS THE BRAZO BOTTOM, LOOKING SOUTH

One of the most difficult tasks connected with the canal is to relocate and rebuild the Panama Railroad, and at the same time not to interfere with the tremendous traffic across the Isthmus. The large lake which is being created by the Gatun Dam will completely submerge the present railway for the greater part of its length. This illustration shows a depression, across which an embankment nearly a mile long, and containing 1,500,000 cubic yards of earth and rock, must be built to hold the railway above the level of the lake.



RELOCATING THE PANAMA RAILROAD ACROSS THE VALLEY OF THE GATUN RIVER: THIS EMBANKMENT WILL BE THREE-FOURTHS OF A MILE LONG AND CONTAIN 1,000,000 CUBIC YARDS



BUILDING GATUN DAM BY HYDRAULIC FILL: LIFT, 63 FEET; LENGTH OF PIPE, 4,300 FEET

The dam is constructed by forming two dumps on the outer lines of the structure and depositing waste material, mostly rock, obtained from Culebra, the lock site, and Mindi. The area between the piles thus formed is filled with the material pumped in by hydraulic dredges, the natural surface of the ground having been previously cleared of vegetation and a suitable bonding trench excavated.

The broken stone for the concrete is quarried and transported from Porto Bello, about 20 miles east of Colon, and the sand is procured from Nombre de Dios, about 20 miles farther to the east. Both are transported direct to Gatun in barges through the French Canal, which was dredged of rock ledges and accumulated deposits for the purpose. Since the canal line was cut through to the French Canal this new channel is also used. The cement is purchased under contract at docks in Jersey City and shipped to Cristobal, thence by barges to Gatun or cars to Pedro Miguel and Miraflores.

The material taken to Gatun in barges is landed at unloading docks, conveniently located on the old east diversion, to which a channel from the French Canal was excavated by dredges. The east dock is inclosed, forming the cement storehouse. Its floor dimensions are 106 feet by 490 feet. The roof projects 35 feet beyond the face of the dock, affording some protection against the rains.

The building is divided into ten bays, in each of which a two-ton traveling crane, worked by electric motors, operate entirely across the building. In the rear of the building 30 cement hoppers are placed in the floors and covered with steel screens. The cement is delivered through these hoppers into cars running on a track below the floor. The cement for this work is in barrels, which are first put into the storehouse and subsequently moved to the hoppers.

Grab buckets, operated by cableways, remove the sand and stone from the barges, moored against the west dock, and deliver the materials in stock piles. The towers of the cableways are of steel, 85 feet high and 800 feet apart. They are mounted on cars, which enable movement at right angles to the line of the cable; one single and two duplex cableways are provided. (See illustration, page 196.) Each of the latter have complete independent cableway systems. The cableways are equipped with five 70 cubic feet self-digging grab buckets, each having an independent run from the barge to the stock pile. The cableways have not the capacity to unload the material required with sufficient rapidity, and have been augmented by three derricks operating on a dock north of the cement shed, transferring sand and stone to bins.

THE AERIAL CABLEWAYS

Two tunnels run north and south through the stock piles, with hoppers in the top through which stone and sand are fed to cars.

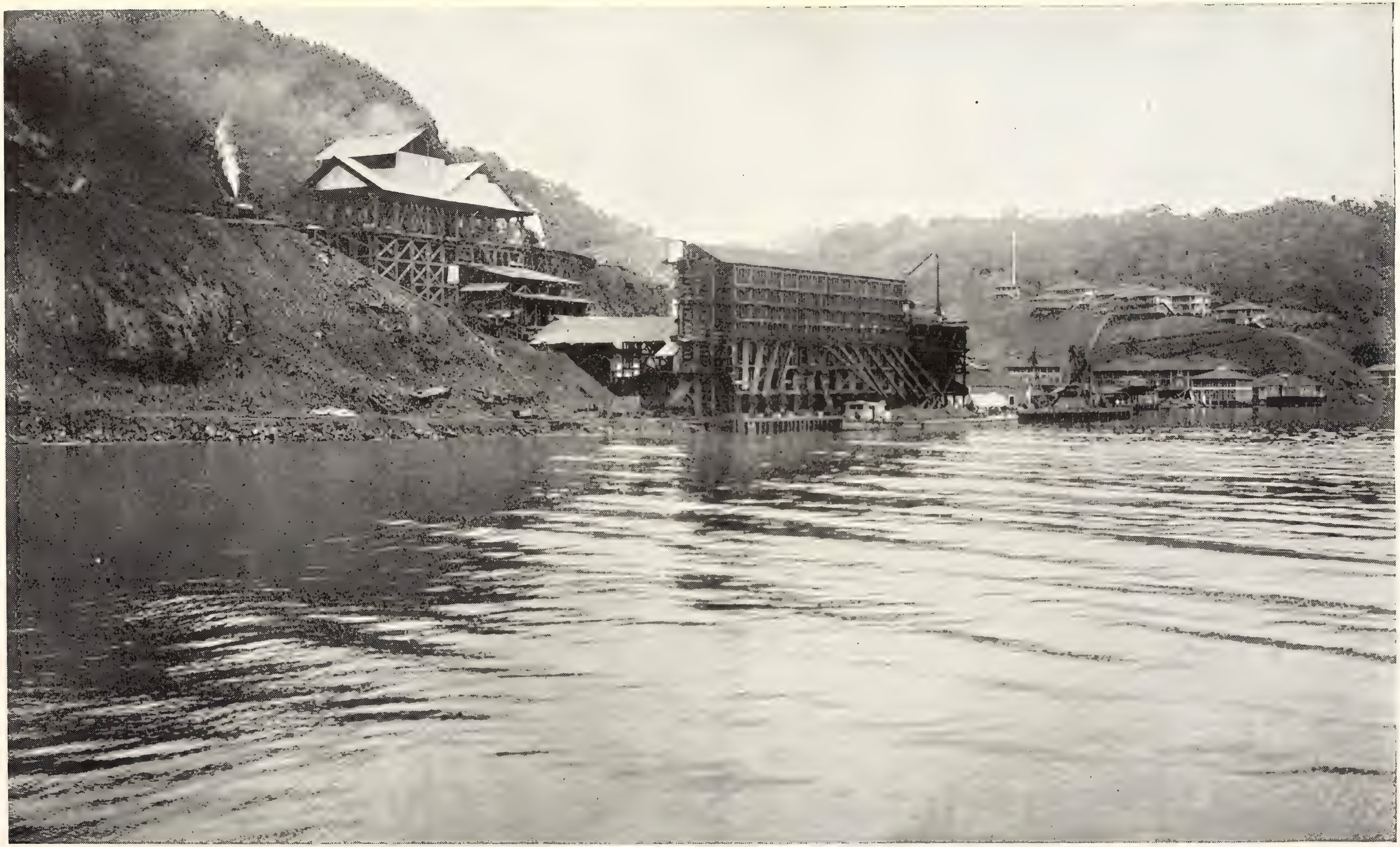
The cars used for transferring the material are of steel with hinged side doors, and bottoms inclined outward at an angle of 52 degrees from the horizontal. A steel partition divides each car into compartments, one for rock and cement and one for sand. The car starts at the cement shed, where it receives two barrels of cement, thence runs through one of the tunnels, receiving a full charge of stone and sand in the proper compartment, and proceeds to deliver this load in the mixer hopper.

The concrete mixers are of the cubical type, each having a capacity of 64 cubic feet. There are eight of them, all mounted in one building on the west side of the lock site, arranged so that four dump in one direction and the other four directly opposite, thus permitting the use of two tracks under the mixers. There is, however, but one track above.

A four-track electric railway, third-rail system, operates the length of the locks and carries the concrete from the mixers to the cableways over the locks, by which it is placed. The equipment for this road consists of 12 electric four-wheel mine-locomotive-type engines and 24 flat cars fitted with automatic couplers, each designed to carry a two-yard concrete bucket. Two charges of concrete are taken by each train and carried to the cableways.

Four duplex cableways span the locks with steel towers 85 feet high and 800 feet apart, similar in design to the unloading cableways.

The forms used in concrete laying are



VIEW OF PORTO BELLO QUARRY, ABOUT 20 MILES EAST OF COLON, SHOWING CRUSHING PLANT AND SHIPPING BINS

This plant, owned by the government, supplies the crushed stone for the concrete work at Gatun. The amount of stone quarried and crushed in the fiscal year 1910 was 549,678 cubic yards, at an average cost for the last six months of $2.6283 per cubic yard delivered in the stock-pile at Gatun, this cost including plant charges and division expenses. The greatest month's output was in June—a total of 74,184 of steel and, for the straight portion of the walls, so designed as to permit construction of monoliths 36 feet in length extending from the floor to the top of the walls. The forms for the main and the lateral culverts are of steel and are collapsible.

FROM GATUN TO THE OCEAN

The channel from the locks to deep water in Limon Bay, approximately seven miles in length, is being excavated in part by steam shovels and the remainder by dredges.

South of the French Canal the Mindi Hills cross the line of our canal between Gatun and Limon Bay, rising to the elevations 50 and 60. As the bulk of the excavation is rock, steam shovels were put to work to secure the requisite width and depth. It was thought that when sea-level was reached the shovels would have to be replaced by dredges, as the Mindi River is within a few hundred yards of the area, and the French Canal borders it. As the work progressed, however, notwithstanding the seamy nature of the rock, it was found that a relatively narrow levee would keep out water from the French Canal, and the seepage was so small as to be easily handled by pumps. One shovel-cut to grade was made, when the high water in December, 1909, flooded the pit and work was suspended until recently, when the soft material was removed by a suction dredge. The water is being pumped from the pit so as to permit completion of the work by steam shovels.

Over the area to be dredged, a seagoing suction dredge removes the softer material, while ladder and dipper dredges handle the rock and stiff clays. The underlying rock is drilled and blasted prior to dredging. A total of over 35,000,000 cubic yards was the estimated amount to be excavated, of which 60.3 per cent is completed.

THE LOCKS AT PEDRO MIGUEL

In the Pacific Division the work consists of the construction of duplicate locks at Pedro Miguel overcoming a 30-foot difference of level, with the necessary dams; two locks in flight, also in duplicate, at Miraflores, connected with the adjacent hills by one earth and one concrete dam; excavating the channels between the locks to the required depths, and the excavation of the channel to proper width and depth to deep water in the Pacific.

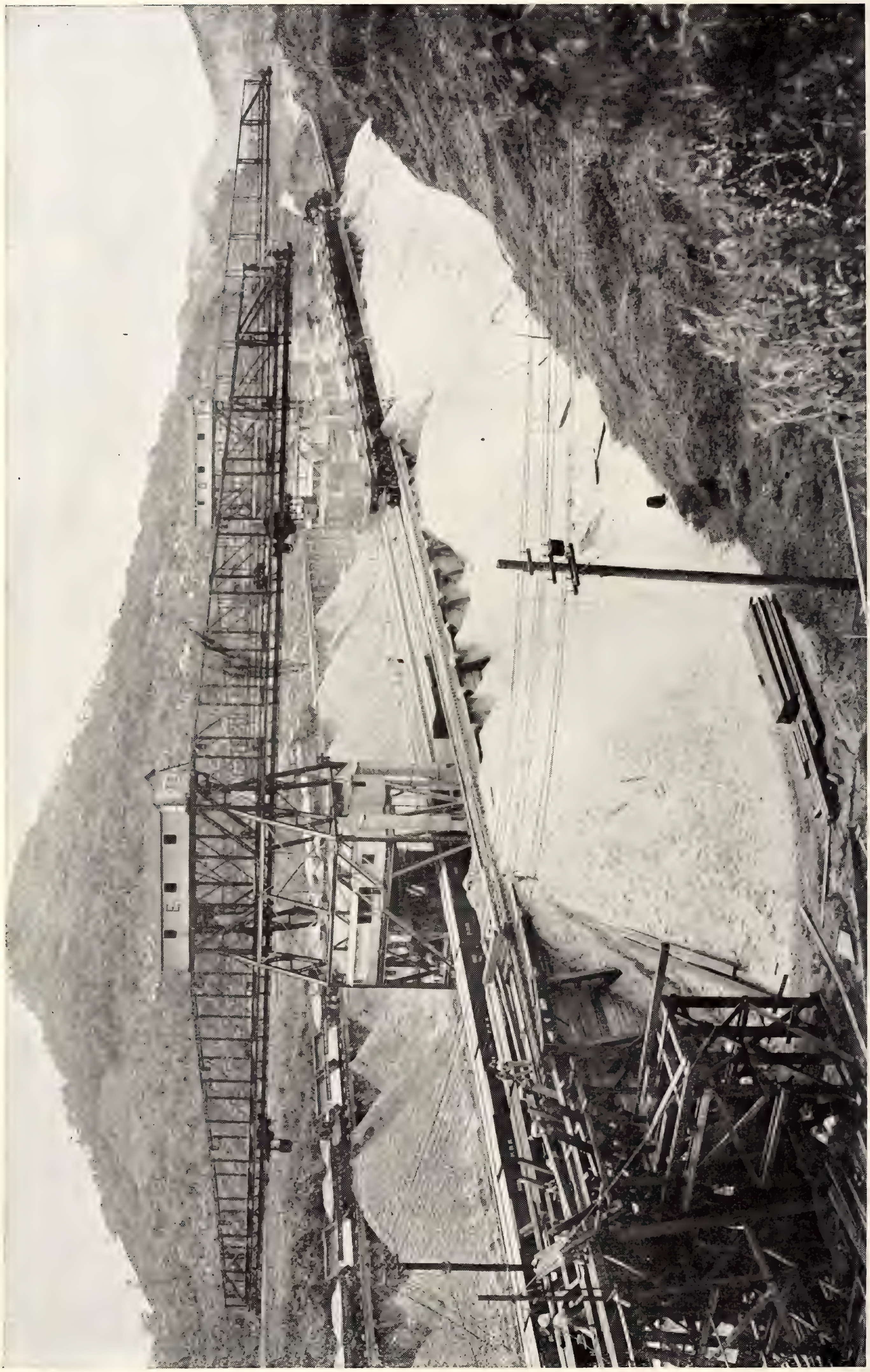
The Pedro Miguel locks connect the summit or 85-foot level with the 55-foot level. The excavation for the locks, amounting to 770,000 cubic yards, is completed, and of the 837,400 cubic yards of concrete required for their construction, 57 per cent is completed.

The west dam connects the head of the locks with the hills to the northwest and performs the same function at the south end of the lake that the Gatun dam does at the north. It is to be of earth, about 1,400 feet long, 40 feet wide at the top, which will be at reference 107 above mean tide, and have side slopes of 8:1. It will be subjected to a maximum head of 40 feet, though the average head is from 25 to 30 feet.

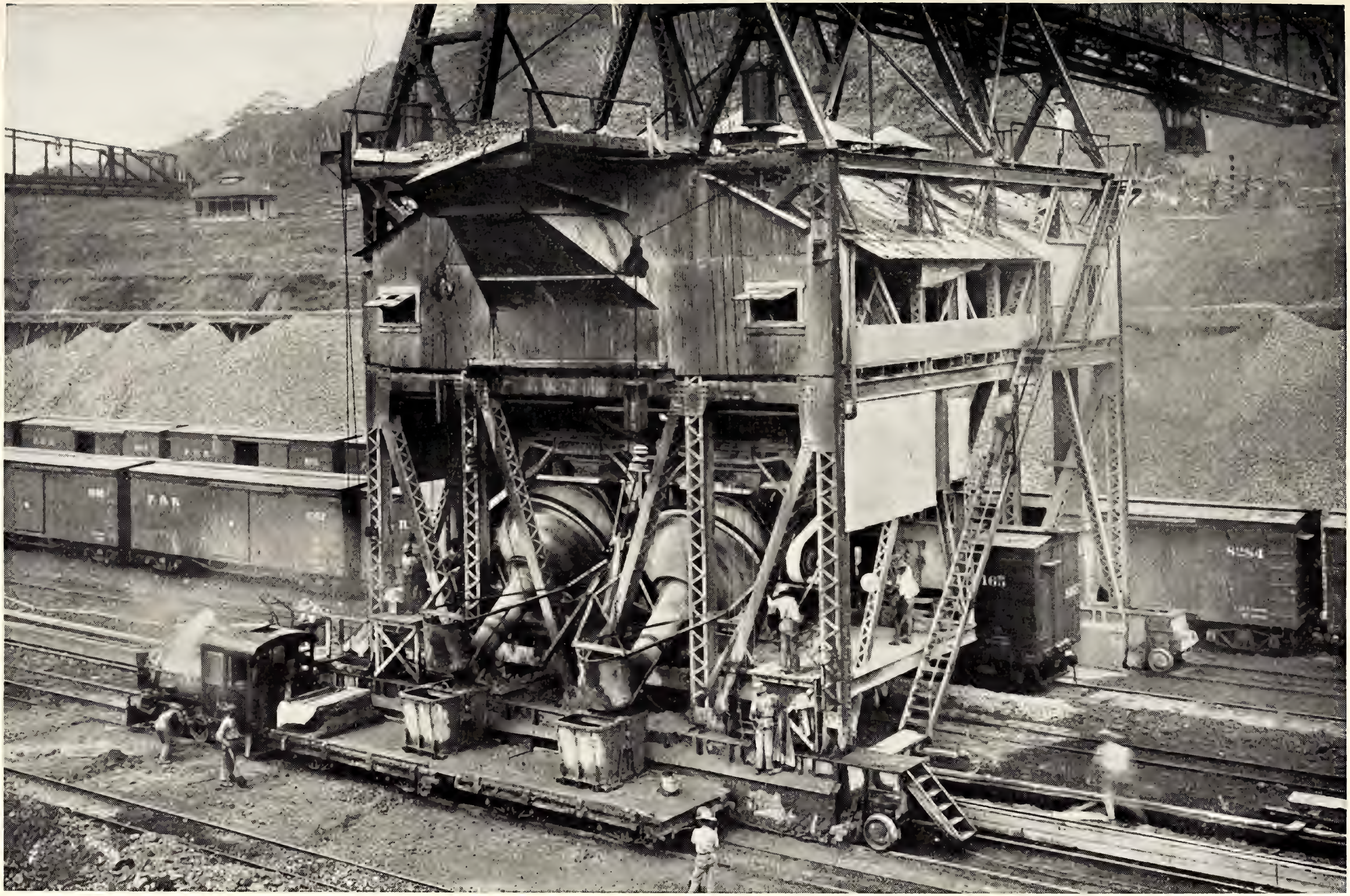
In its construction two rock piles are formed; between these two masses of material (from which an existing stratum of gravel was removed), selected material will be placed properly puddled and rolled. This central portion will have a thickness of 140 feet at the bottom. Concrete core walls will connect the dam with the hill and lock. The dam, which contains about 1,000,000 cubic yards, is 26 per cent completed. The natural surface of the ground from the east wall to an adjacent hill is above the upper level, but it is to some extent pervious to water. To cut off any possible flow, the lock wall is returned toward the hill, with which it will be connected by a concrete core wall.

THE LOCKS AT MIRAFLORES

The Miraflores locks are two in flight, overcoming the difference in level between Miraflores Lake, whose surface is at reference 55, and the sea-level section. As the fluctuations in tide are about 20 feet and mean tide is the datum, it will

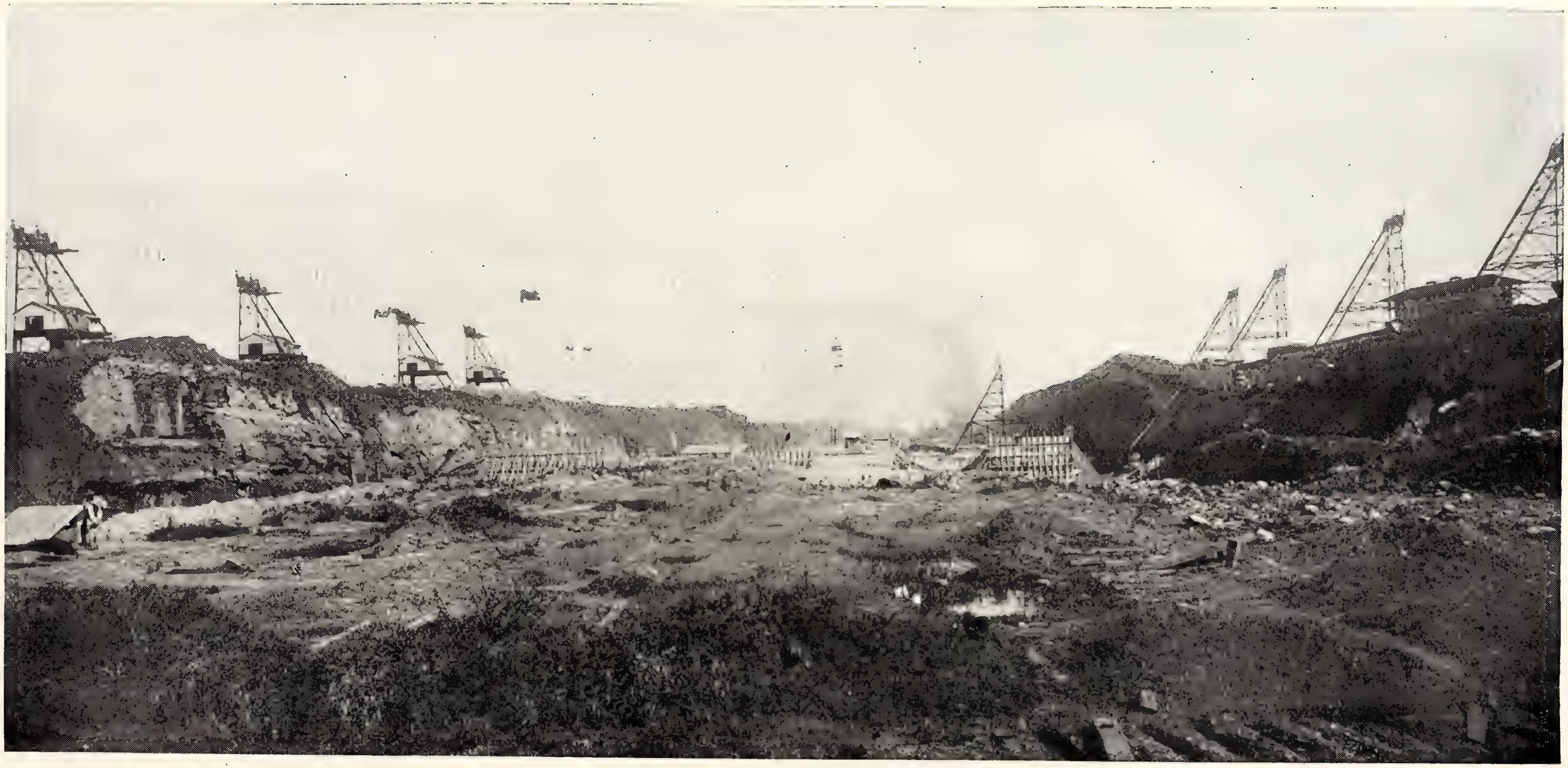


To handle the millions of tons of stone, sand, and cement required for building the locks, ingenious machinery has been installed which automatically selects the right proportions of stone, sand, and cement and mixes the material. The piles in the foreground in the above picture are sand; the darker piles on the further side of the railway track are stone. Grab-buckets shoot down from the arms of the crane, bite into the piles, shoot back to the crane, and feed their loads into the mixer, where cement has been already delivered in bags or barrels.



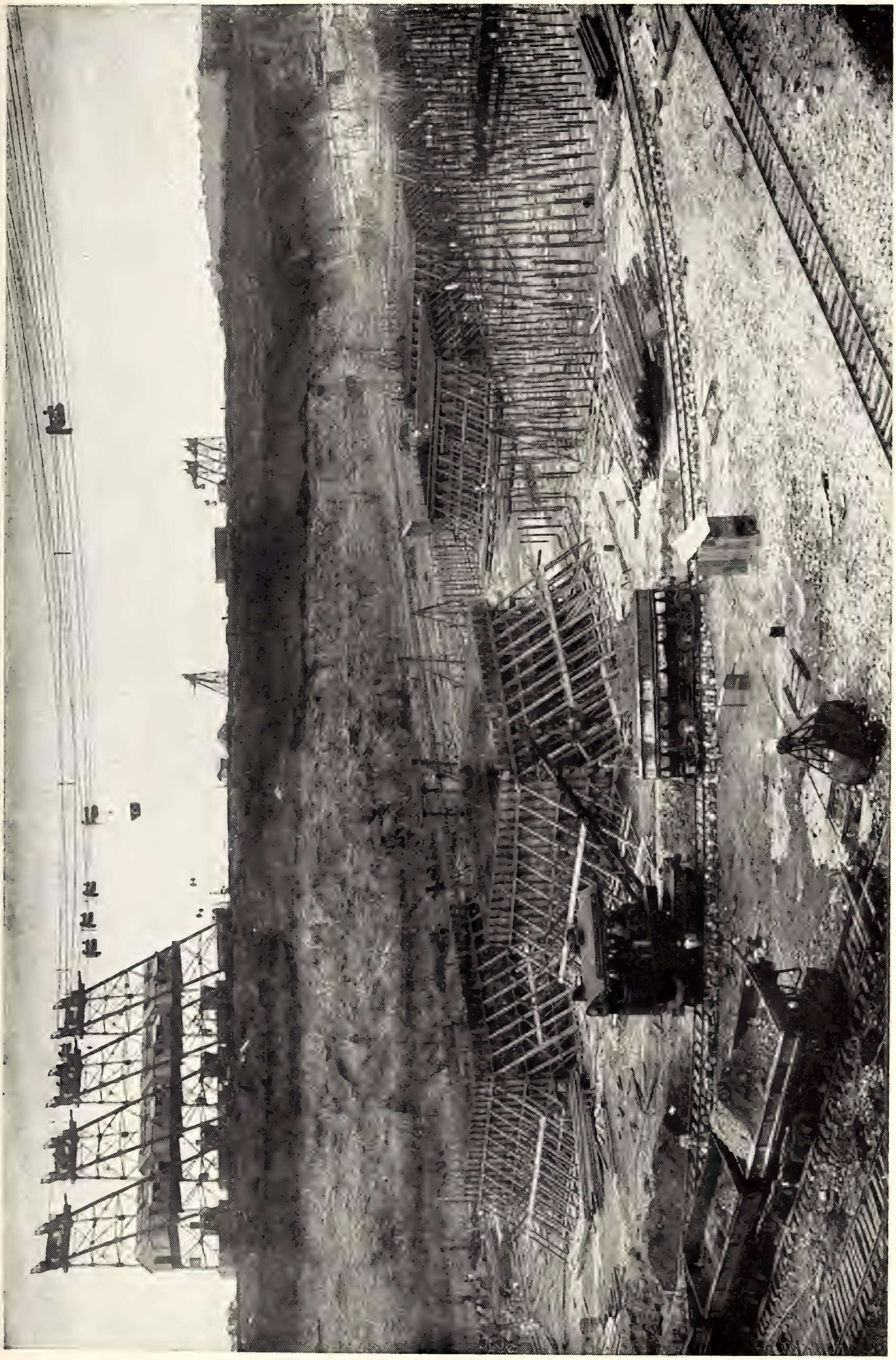
ONE OF THE AUTOMATIC CONCRETE MIXERS LOADING CONCRETE IN BUCKETS

The government has contracted for 4,500,000 barrels of cement for the various locks, dams, and structures of the canal. If these barrels were placed in a single line touching each other they would reach from New York to Denver



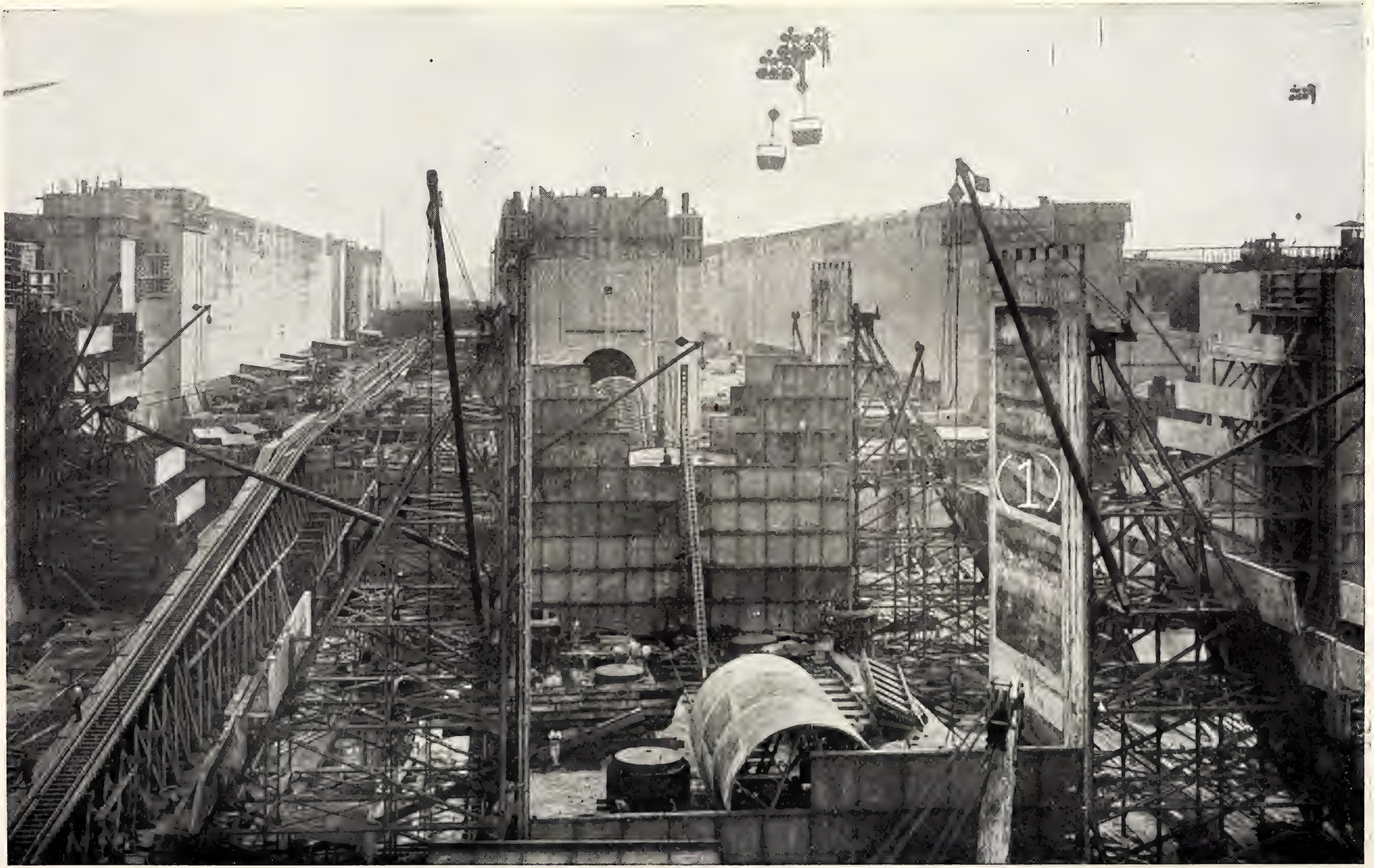
GENERAL VIEW OF UPPER LOCKS AND FOREBAY, GATUN, LOOKING NORTH, IN 1909

Four duplex cableways span the locks, with steel towers 85 feet high and 800 feet apart. They pick up from the delivery car the big buckets of concrete, send them out on the aerial trams, and lower them where required. One man operates a cableway, controlling all the movements by switches located on a platform on each head tower. In addition to delivering concrete in the locks, the cableways are used to lift material from the lock site and dump it by an aerial dumping device, to handle forms for the concrete work, and to handle the parts of the gates and the gate-operating machinery. The carrying cable is a locked steel wire 2¼ inches in diameter, its carrying capacity being considerably over 6 tons. Twenty trips an hour can be made on each cableway. The greatest lift is 170 feet. The towers are set on tracks on which they can be easily moved along the lock site as the work progresses.



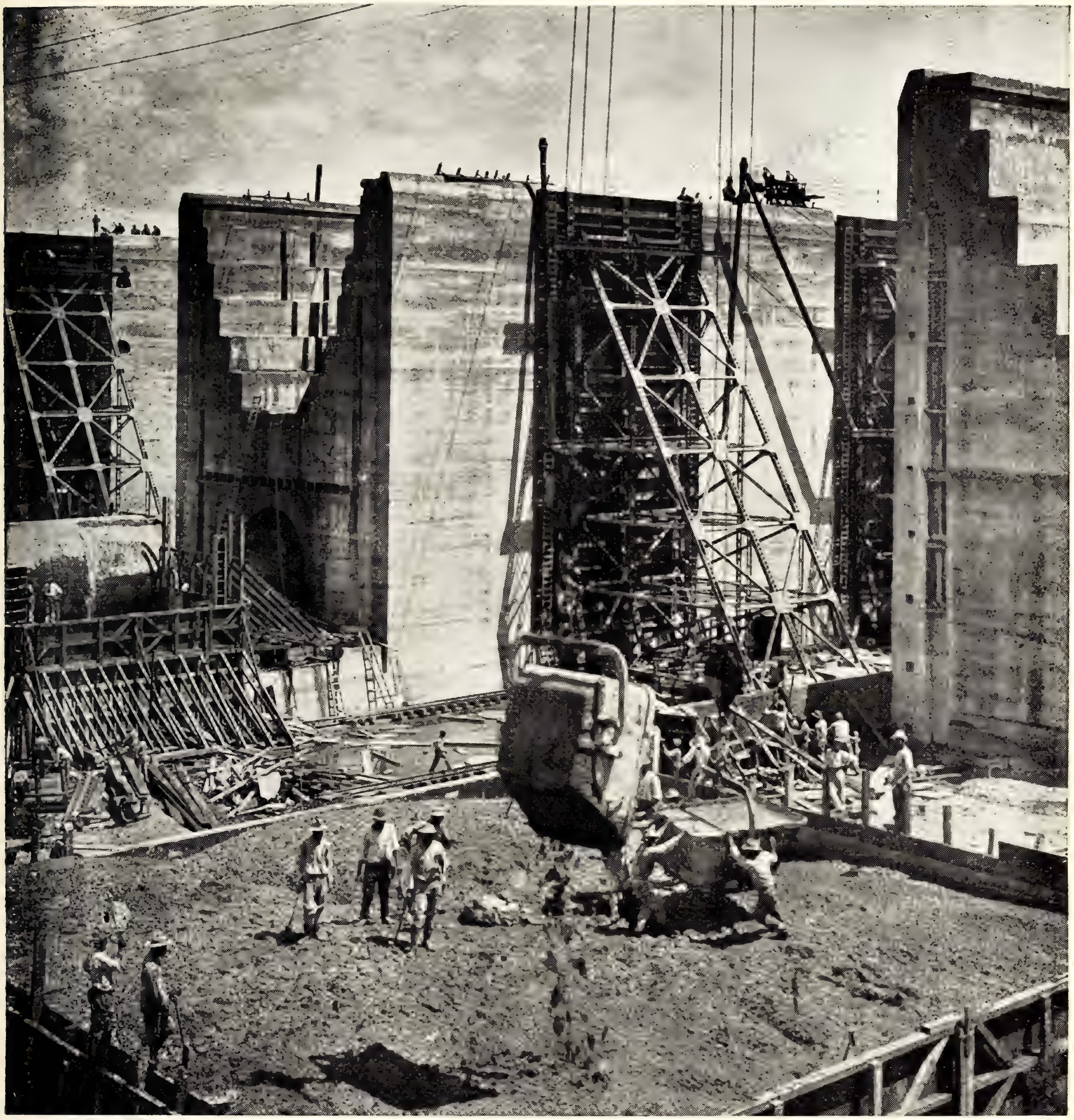
ANOTHER VIEW OF THE AERIAL CABLEWAYS USED AT THE GATUN LOCKS: LOOKING NORTH FROM EAST BANK, AUGUST 25, 1909

This illustration shows the early stages of the construction of these locks. The two “squares” on the left are timber forms in which concrete was laid in sections for the foundations. The uprights on the right are old French rails imbedded in the concrete to reinforce the floor. The floor of the Gatun locks varies in thickness from 13 to 20 feet of solid concrete reinforced with these rails.



BUCKETS OF CONCRETE READY TO DESCEND AND BE PLACED BY THE MEN WAITING BELOW

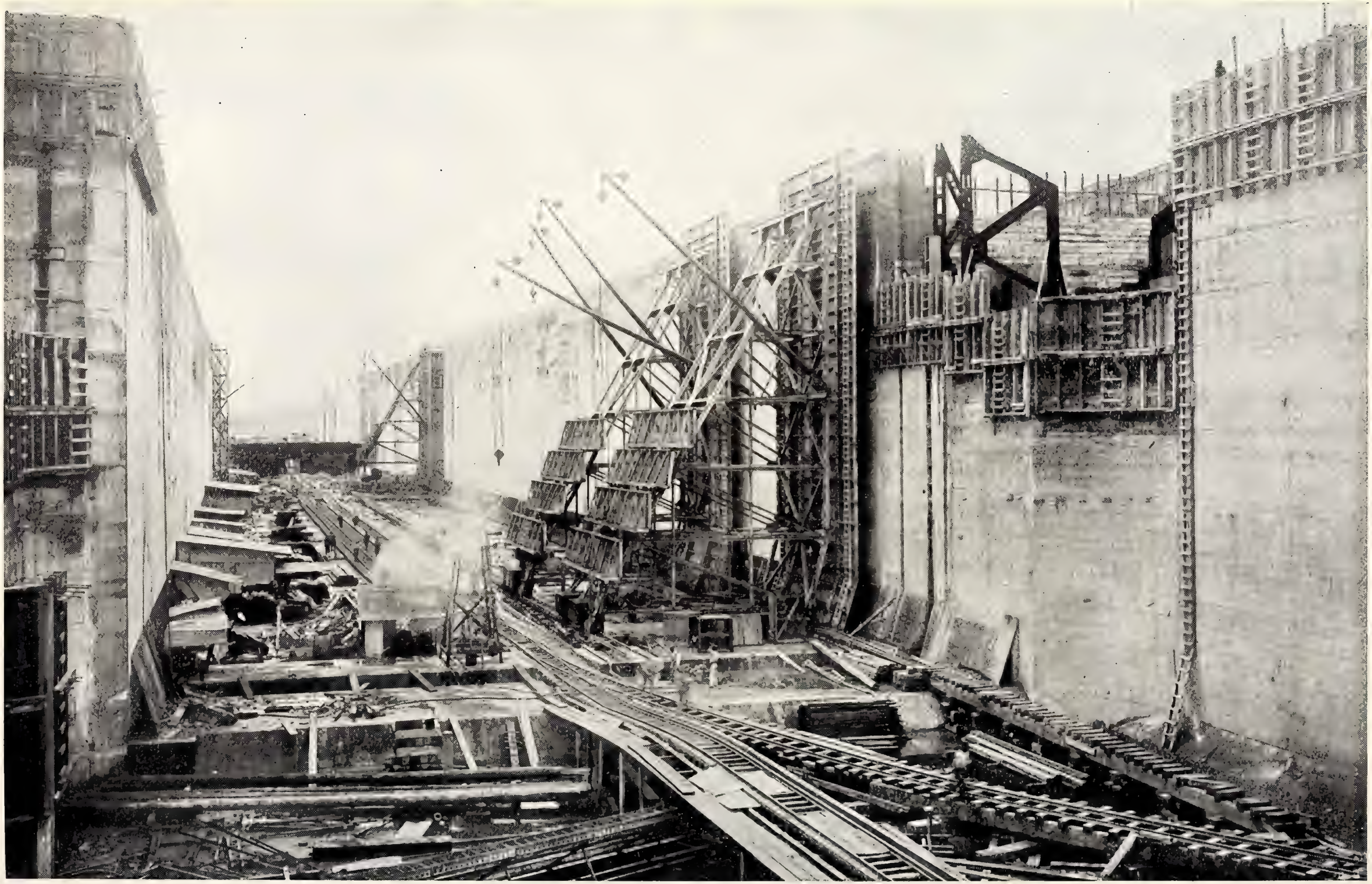
This view of the upper locks at Gatun (looking south from the middle lock) was taken December 30, 1910, and shows the walls of the twin upper locks practically completed. Note the steel forms (1) for the construction of the walls (see pages 200, 204, and 205)



RECEIVING THE CONCRETE

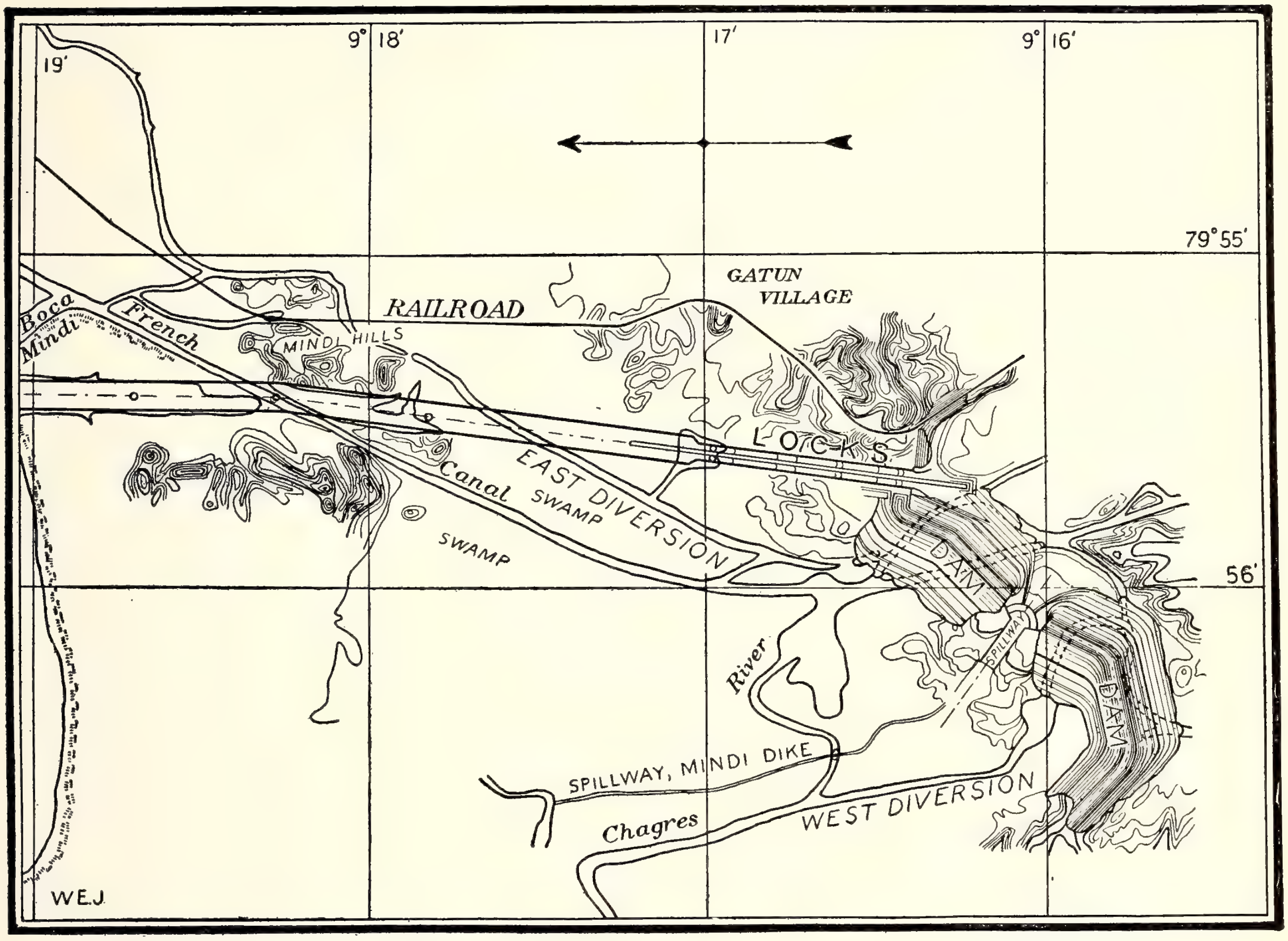
Note the men standing on top of the wall on the extreme left. The largest amount of concrete laid in any one month at Gatun is 89,401 cubic yards. The average cost of the concrete per yard in place for 1910 was $7.355, including plant charges and division expenses. To build the Gatun locks 2,250,000 barrels of cement will be required.

be noted that the maximum lift for these locks is about 65 feet. The excavation for the upper set of locks is complete and for the lower set it is about 70 per cent complete. It was not intended to lay any concrete until the plant at Pedro Miguel had finished the locks at that locality, but, as the work has advanced so much more rapidly than anticipated, and as the contractors are to complete the erection of the gates seven months earlier than expected, it became necessary to install auxiliary mixers and begin this part of the work earlier. There will be



THE EAST CHAMBER OF THE UPPER LOCKS AT GATUN, LOOKING SOUTH: DECEMBER 16, 1910

Note the steel towers for holding the face forms, which in this view are shown moved away from the wall preparatory to removal to a new location (see pages 198, 204, and 205). Each lock at Gatun is 110 feet wide and has a usable length of 1,000 feet



MAP OF GATUN DAM, SPILLWAY, AND LOCKS (SEE PAGES 177 AND 179)

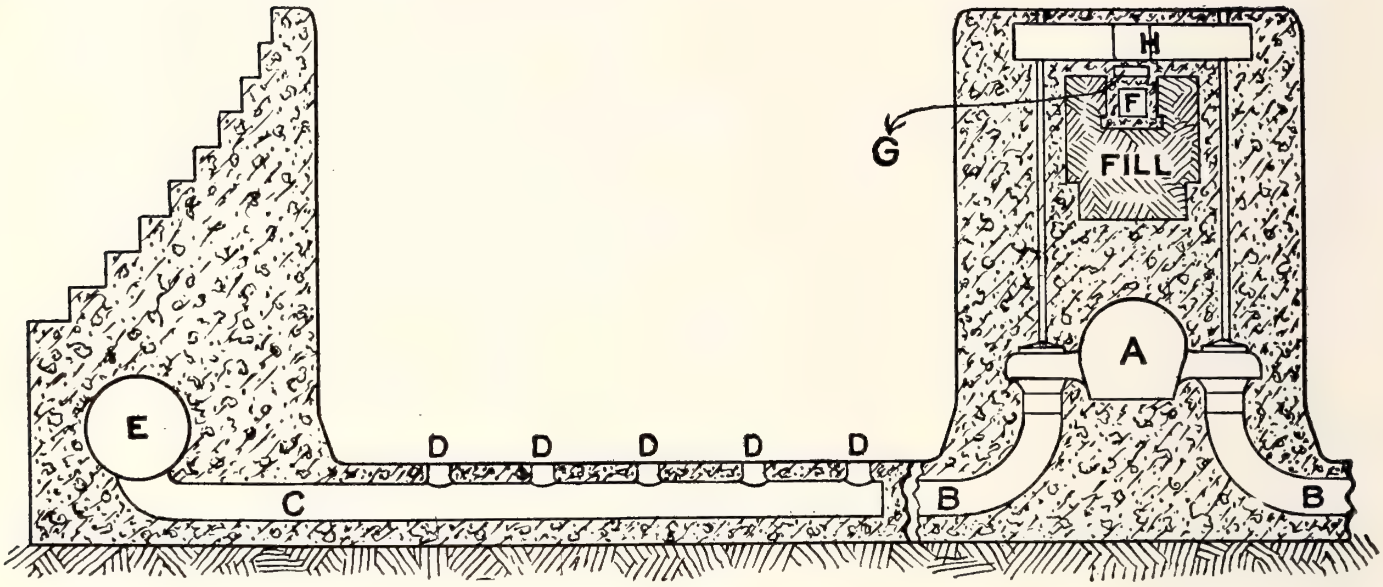
a total of 1,312,200 cubic yards of concrete to lay for these locks, of which 7 per cent is already done.

The Cocoli River, a tributary of the Rio Grande, crosses the site of the Miraflores locks from the west, and is such a formidable stream in times of heavy freshets that the protection of the locks against its floods during construction and after completion is necessary. A diversion channel through the hills to the west with a dam across the river valley would accomplish the desired end; but, as a dam at the head of and to the west of the locks is also necessary to impound the water for the pool above, the solution finally adopted was the construction of a dam extending from the head of the locks to Cocoli Hill, with a direction nearly parallel to the axis of the locks; by this arrangement the Cocoli River will discharge into the upper pool.

The dam is of earth, 2,300 feet long, top width 40 feet at reference 70, and the side slopes approximately 12:1. The average head to which the dam will be subjected is 30 feet, the maximum 40 feet. It is being constructed like the Gatun dam, and is 43 per cent complete. The east dam will be of concrete, approximately 500 feet long, provided with regulating works similar to and of the same dimensions as those at Gatun, the crest in this instance being at elevation 39, with seven openings, permitting a discharge of 7,500 cubic feet per second.

For a distance of one and one-half miles south from the Miraflores locks rock is found in the channel, to be excavated at an average elevation of minus 30. The estimated quantity to be removed is 1,503,260 cubic yards, which is covered by 8,158,133 cubic yards of alluvial material, averaging 38 feet in depth. It was not practicable to remove the earth and rock by dredging and subaqueous methods, as the requisite plant could not have been assembled to complete the work in the allotted time.

An hydraulic excavating plant was,



CROSS-SECTION OF LOCK CHAMBER AND WALLS, GATUN LOCKS

A. Culvert in center wall.
B. Connections between center and lateral culvert.
C. Lateral culvert.
D. Wells opening from lateral culverts into lock chamber.
E. Culvert in side wall.
F. Drainage gallery.
G. Gallery for electric wires.
H. Passageway for operators.

There will be three main culverts extending the full length of the locks, one in each of the side walls and one in the middle wall. The side-wall culverts are 22 feet in diameter from the intake at the south end of the upper locks to a point 320 feet north, where they are reduced to 18 feet, at which diameter they will continue to the end, a distance of about 3,500 feet. The culvert in the middle wall is 22 feet in diameter from its south end to a point 120 feet north, where it also will be reduced to 18 feet, at which diameter it will continue to the end, a distance of about 3,600 feet. Lateral culverts in the form of an ellipse will run in the floor from and at right angles to the main culverts at intervals of 32 and 36 feet, leading alternately from the side and middle culverts. Water will be delivered or collected by each lateral culvert through five openings or wells in the floor. Valves, which may be opened or closed either individually or all at one time, will be located at the intakes and outlets of the main culverts, and at the connections between the center culverts and the lateral culverts (see page 205). In the center space of the middle wall there will be a tunnel, divided into three stories or galleries. The lowest gallery is for drainage; the middle, for the wires that will carry the electric current to operate the gate and valve machinery, which will be installed in the center wall, and the top, a passageway for the operators.

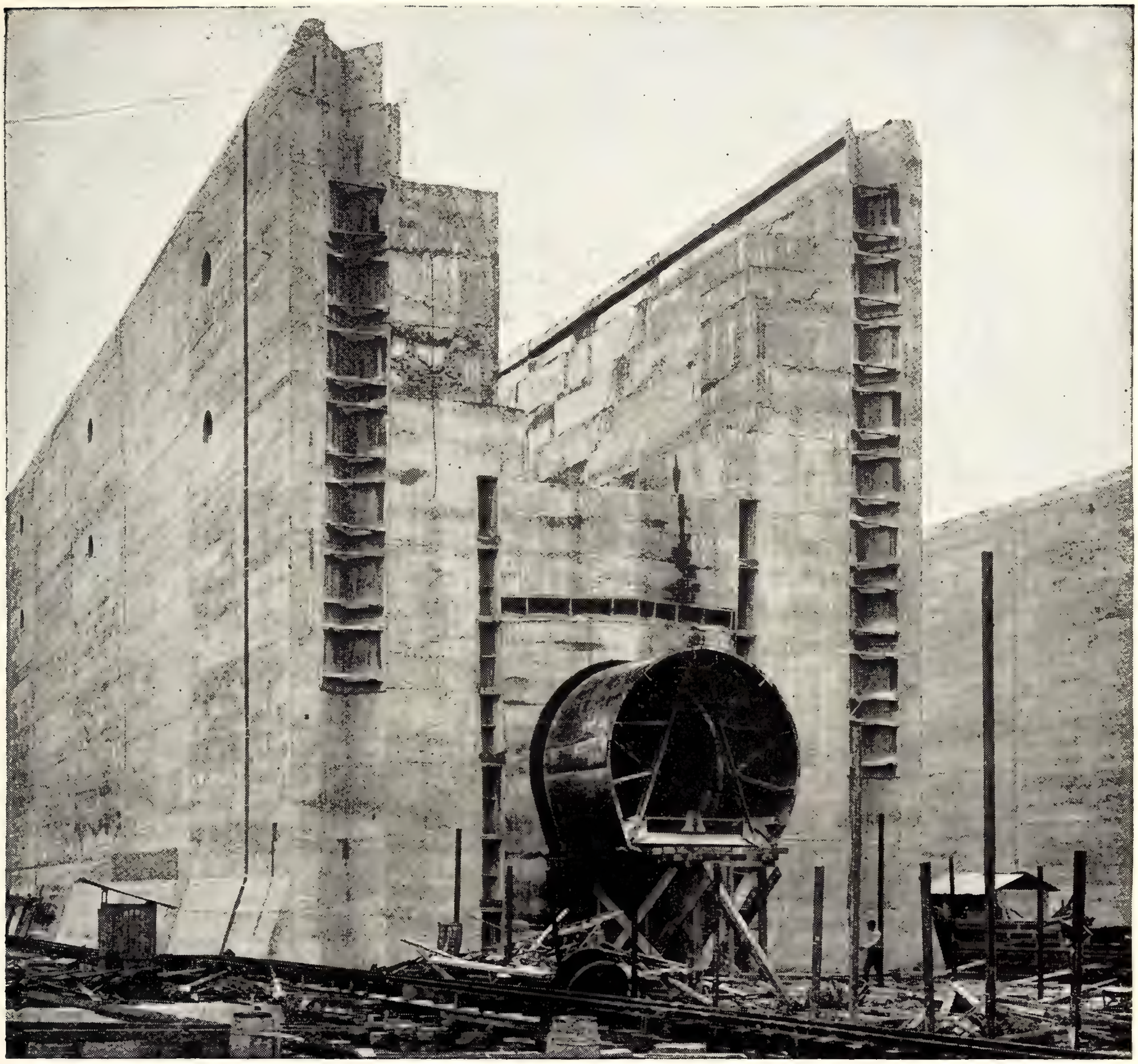
therefore, selected as being the cheapest and most expeditious method of handling the loam, especially because by this means 450 acres of swamp land adjacent to the canal could be reclaimed. Four hydraulic pumps force water through pipes, fitted with hydraulic giants or monitors, with a pressure of 130 pounds per square inch at the nozzles; these jets wash the loam to sumps, from which 18-inch centrifugal dredging pumps, mounted on reinforced concrete barges, pump the material to such places as may be desired.

Below the area to be excavated in this manner, the channel is secured by ordinary dredging operations. Rock encountered is blasted, the drilling being done by churn drills through the natural surface to the proper depth or, where submerged, by use of a drill scow. A Lobnitz rock breaker is also in use for preparing the rock for the dredges. The total amount of material to be excavated aggregates 35,000,000 cubic yards, of which 73.55 per cent is completed.

REBUILDING THE RAILROAD

The relocated Panama Railroad is being pushed forward so as to keep pace with canal construction work. From Colon to Mindi and from Corozal to Panama, the old line, relieved of some of its curvature, will be used, but the remainder must be rebuilt. From Mindi to Gatun, two miles, and from Paraiso to Corozal, four miles, the new line is completed and is being operated.

Just south of Miraflores the new road passes through a tunnel 800 feet long.



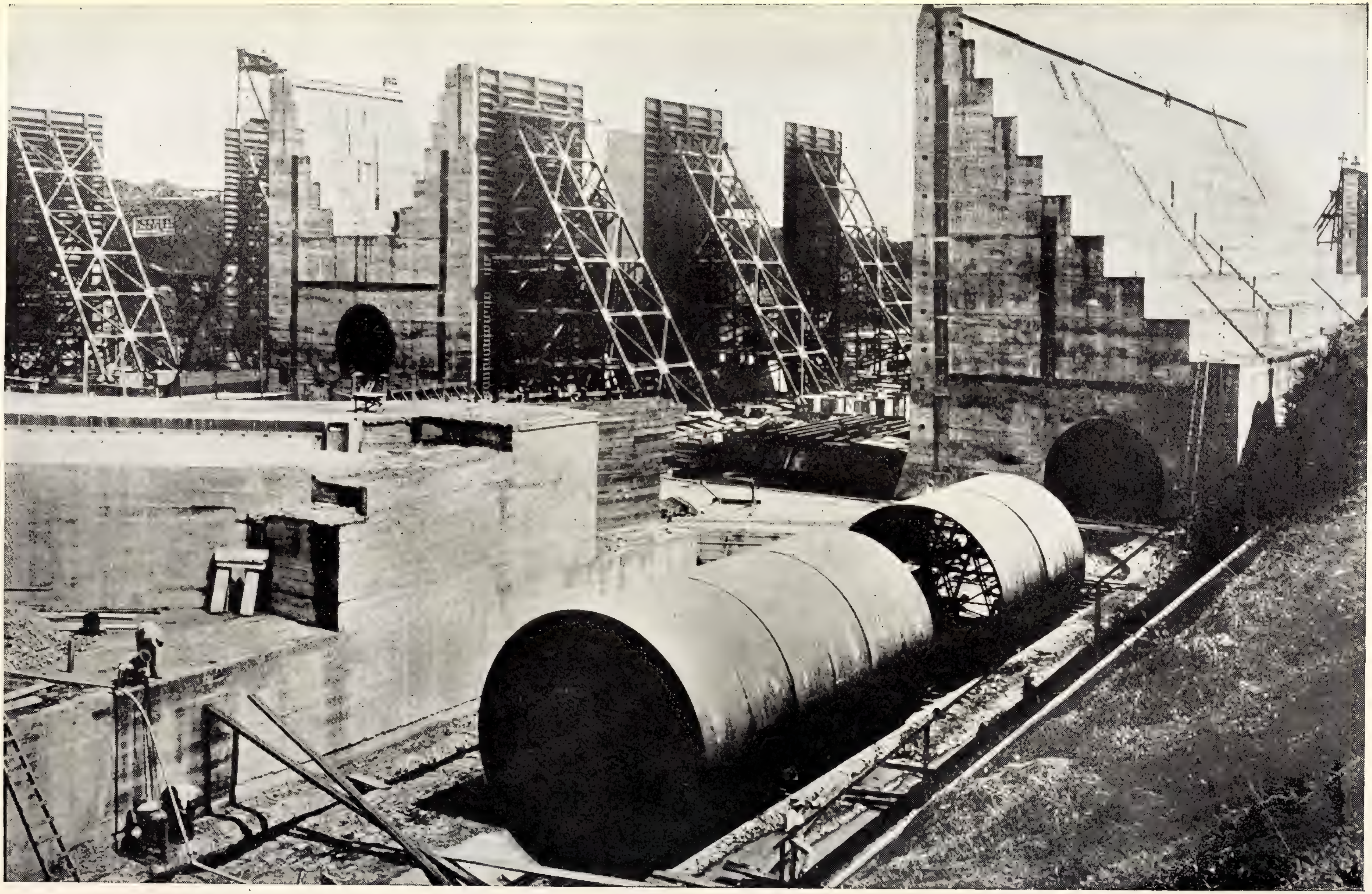
THE MIDDLE WALL OF THE GATUN LOCKS

The size of the structure can be appreciated by noting the man at the bottom. The great cylinder is the culvert to fill or empty the locks (see page 202)

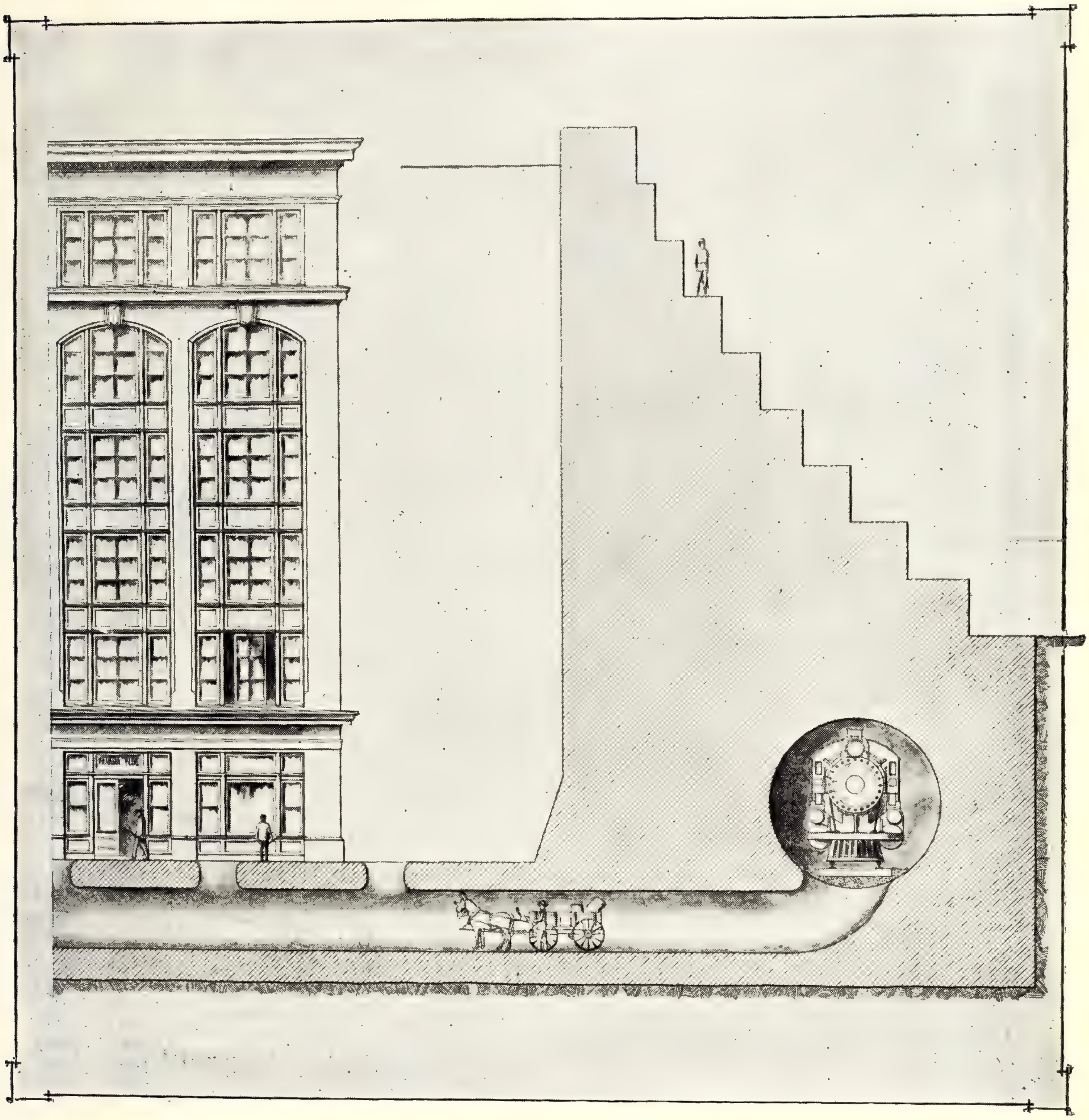
The section from Frijoles to Gamboa, 9 miles, is complete to grade and has been turned over to the Central Division for use in wasting material. This includes a steel bridge across the Chagres nearly one-quarter of a mile long. From Gatun to Frijoles a temporary line was completed up to grade 60 in April, 1910, and maintained ready for operation at any time during the past wet season that the old line was flooded out.

About 3,000,000 cubic yards are still required to complete the embankments of this section to elevation 95, and every effort is being made to finish the entire line to Gamboa, 31 miles, to full grade by January 1, 1912. On this date it is expected that work in the Gatun spillway will have progressed sufficiently to begin raising the lake to elevation 55.

Construction of the line from Gamboa to Paraiso, east of the cut, was started in January and will be pushed with a view to completion by January 1, 1912, if possible. As the greater part of the road passes through the lake, reinforced concrete culverts are provided to equalize the water on both sides of the embankments.



The great barrels are the steel collapsible forms for the culverts in the side wall. The steel towers in the distance hold the face forms (see page 198). Forms for the culverts are made of open-hearth boiler steel, are collapsible, are mounted on wheels to facilitate withdrawal, and are constructed to stand five years of continual use. For the main culverts in the side walls there are 21 forms in 12-foot lengths, each form weighing not less than 14,443 pounds. There are 12 forms for the culvert in the middle wall, each 12 feet long and weighing not less than 14,750 pounds. There are 100 forms for the lateral culverts, each 10 feet long and weighing not less than 2,170 pounds.

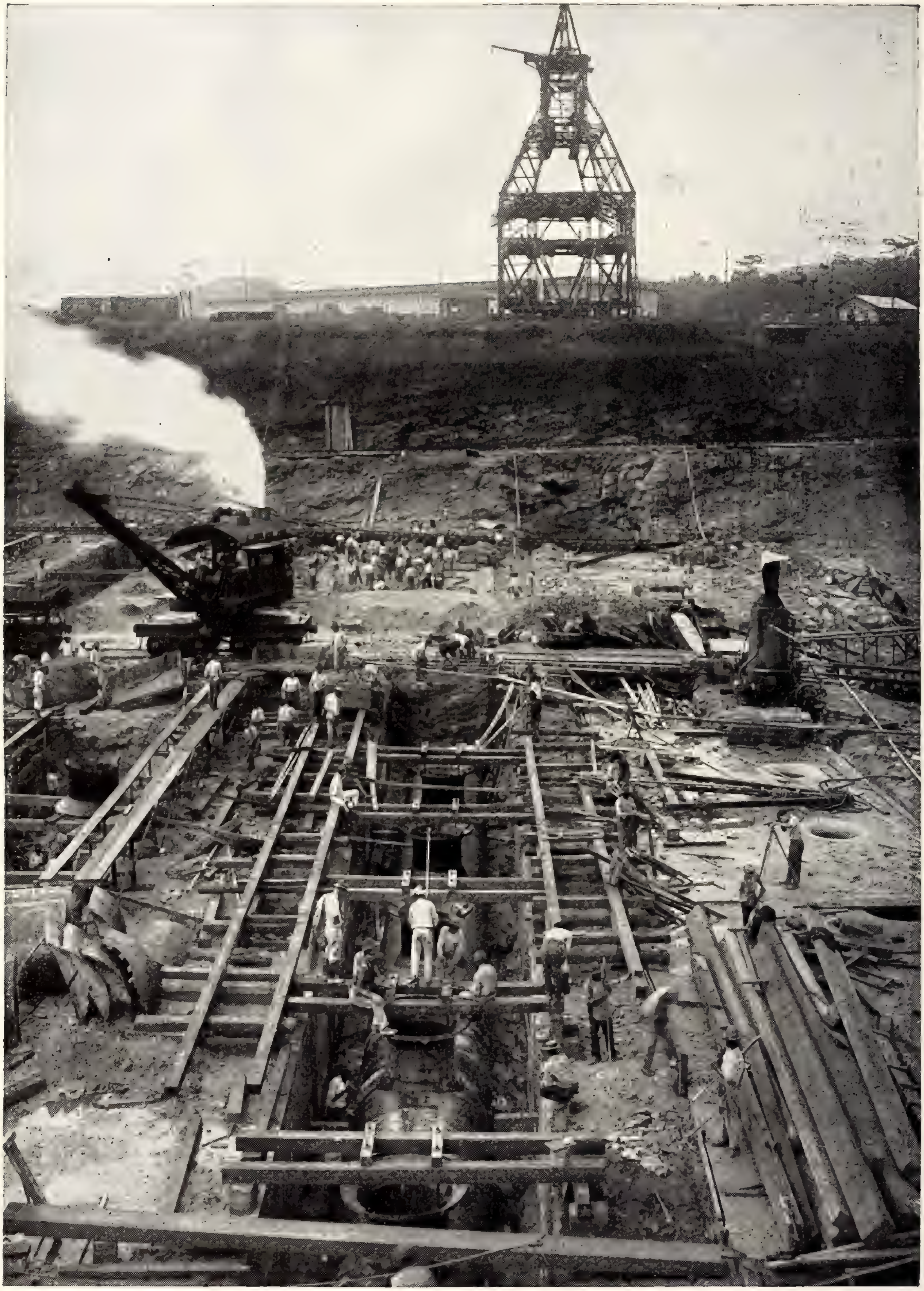


THE SIDE WALL OF ONE OF THE GATUN LOCKS COMPARED TO A SIX-STORY BUILDING

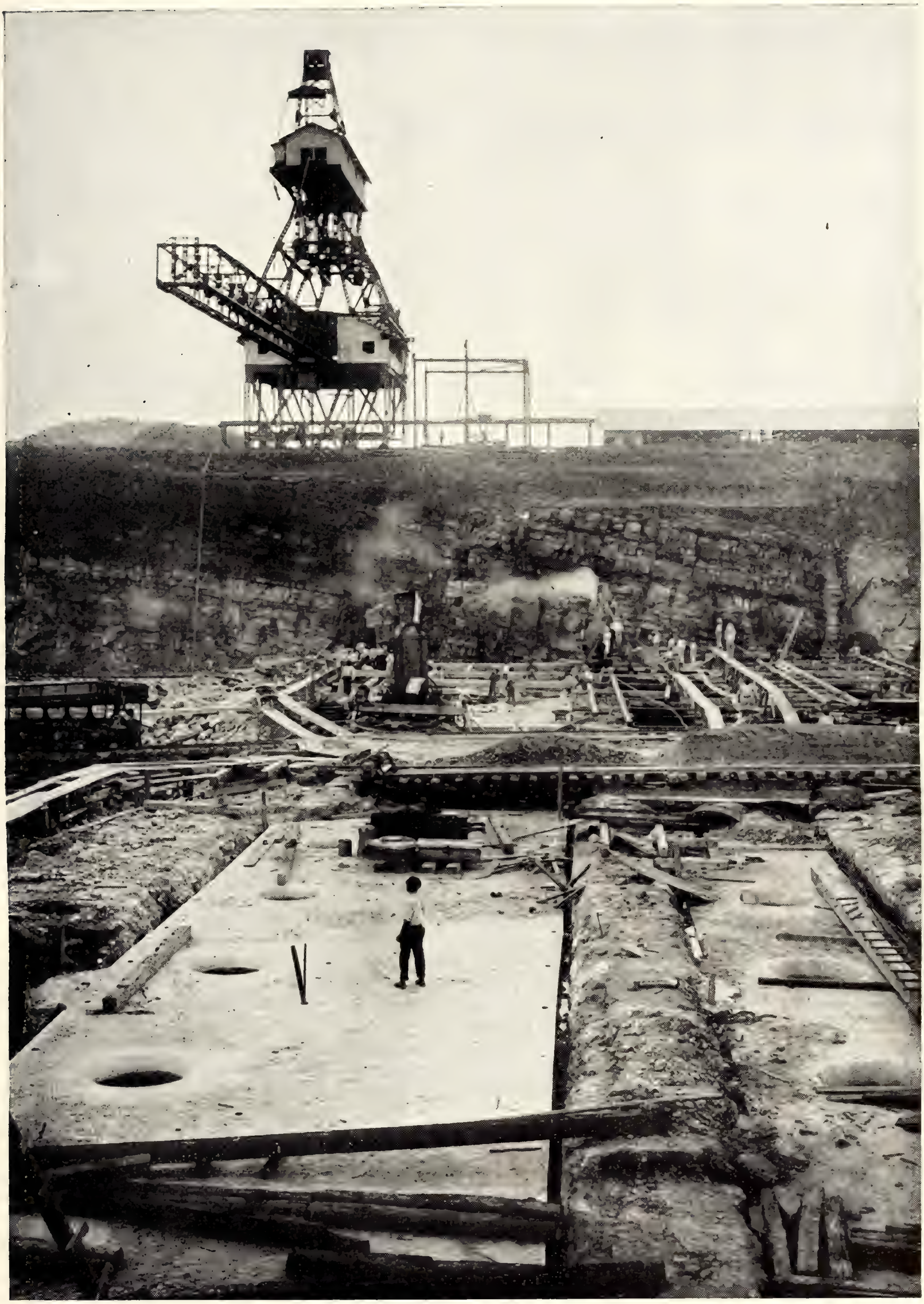
The size of the culverts may be appreciated from the engine and dray. The "steps" will be filled in with earth and stone and graded to the top. Face forms for the side and center walls (see preceding illustration) are of sheet steel carried on movable towers, also built of steel. Tracks are laid as near to the line of the walls as possible, and on these tracks the towers move up and down the lock chambers parallel with the walls (see page 200). Jacks fixed to the towers and bearing on the forms are used to align the forms and hold them in place. There are 12 of these towers, with forms 78 feet long from top to bottom, 36 feet wide, and 7½ inches thick (see page 198).

THE CANAL WILL BE COMPLETED ON TIME

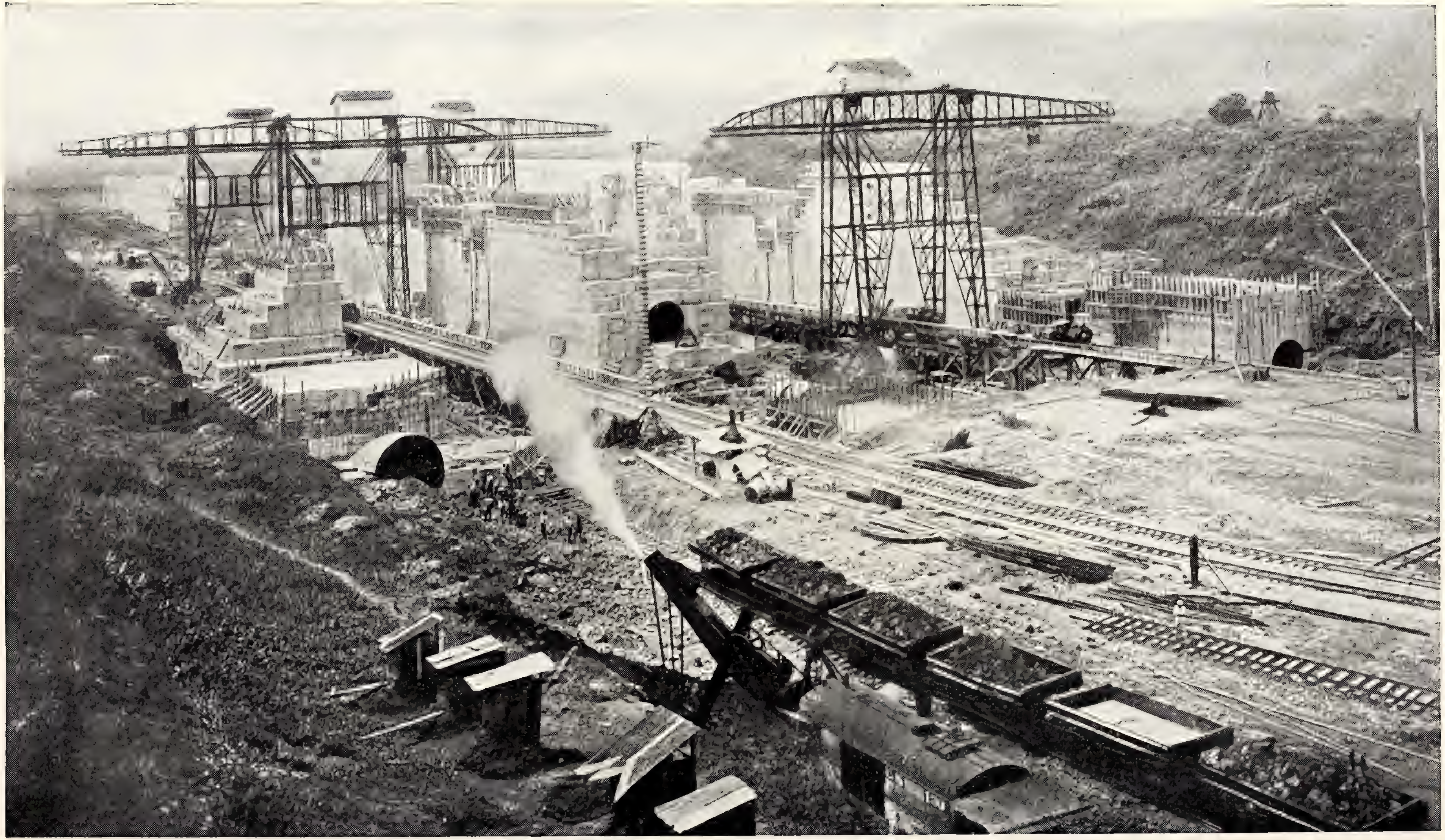
Generally speaking, employees are selected on account of their special fitness for the work in hand, and are then unhampered in their methods of securing definite results, thus bringing out to its fullest extent individual effort and brain power. As a consequence each man has a personal interest in the work and seems imbued with the idea that the success of the enterprise depends on him. The spirit of enthusiasm and of loyalty



PLACING THE FORMS FOR THE LATERAL CULVERT IN THE MIRAFLORES LOCK

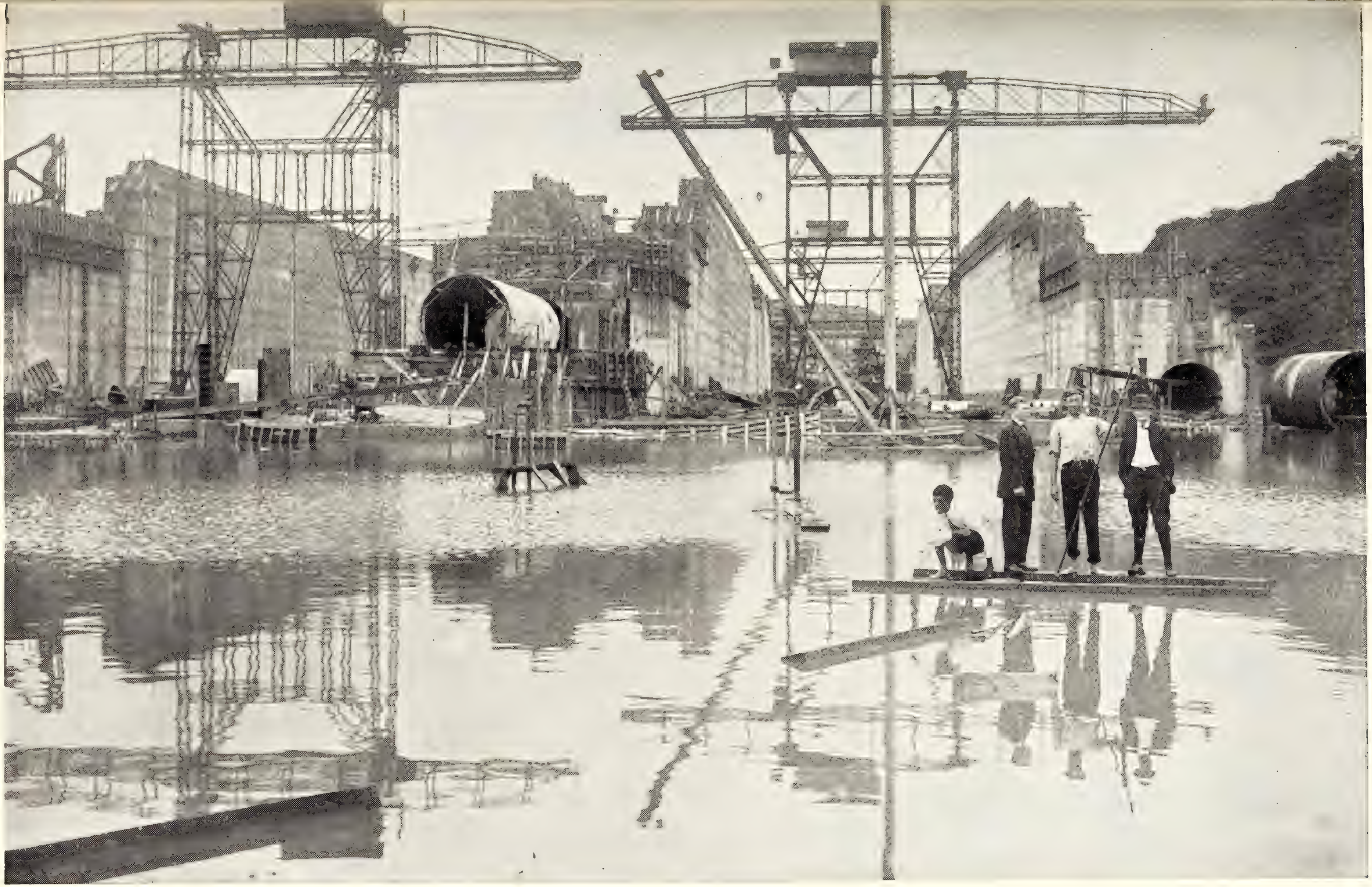


ANOTHER VIEW OF THE FLOOR OF THE MIRAFLORES LOCK, SHOWING THE OPENINGS TO THE CULVERTS BY WHICH THE LOCK WILL BE FILLED AND EMPTIED



VIEW OF THE PEDRO MIGUEL LOCKS, LOOKING SOUTH FROM THE EAST BANK: AUGUST 30, 1910

The steep banks on either side make the arrangement of aerial cableways used at Gatun impracticable, and hence these chamber cranes are used. Each crane is mounted on four heavy freight-car trucks, which carry it along as the work progresses. All the machinery is in the house on top of the tower.



A VIEW OF THE PEDRO MIGUEL LOCKS (LOOKING NORTH FROM THE SOUTH END) TAKEN DURING A FLOOD: DECEMBER, 1910

The isthmus is not 50 miles wide where the canal cuts it, and yet the rainfall varies to an extraordinary degree in this short distance. At La Boca, on the Pacific, the average fall recorded for 12 years is 69 inches per year, while at Bohio the average for 13 years is 130 inches per year, and at Christobal, on the Atlantic, 128 inches per year for a period of 38 years. The months of January, February, and March are practically rainless. In the seven months from May to November, inclusive, 85 per cent of the rainfall occurs.

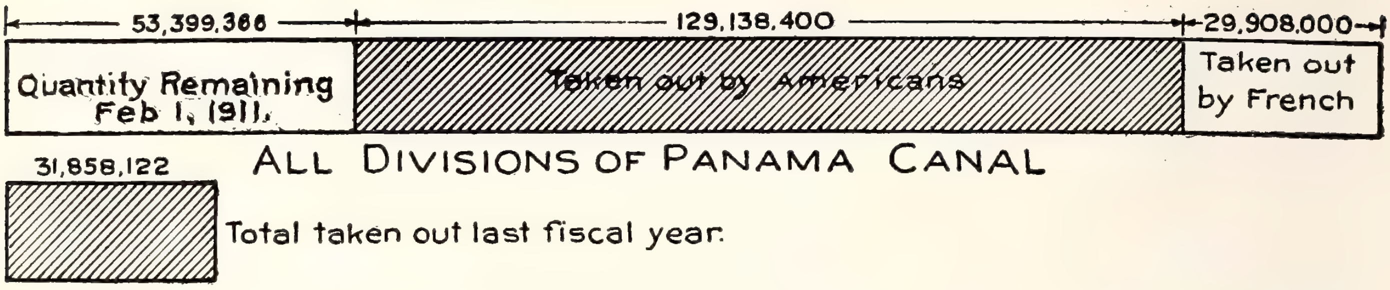


DIAGRAM TO SHOW PROPORTION OF EXCAVATION OF CANAL ALREADY COMPLETED

The quantity remaining to be excavated may, however, be considerably increased by slides into Culebra Cut (see pp. 167 and 173). The figures are cubic yards

among the canal workers strikes forcibly every one who visits the Isthmus, and convinces the doubting that the canal will be built.

The time required for completing the lock type of canal was estimated by the Board of 1905, which made its report in January, 1906, at 9 years, in accordance with which the work should be completed by January 1, 1915, and this is still retained as the date for the official opening. The expectation that the locks will be completed by June 1, 1913, is dependent on the gate contract and has already been noted, which leaves Culebra Cut as the doubtful factor.

THE SLIDES IN CULEBRA CUT ARE THE ONE DOUBTFUL FACTOR

Assuming that all the material will slide into the cut that was estimated in June last, so that all of it will have to be removed, it is estimated that this part of the cut will be finished by September 1, 1913. It is well within possibility—indeed, it is probable—that other slides or breaks will develop, and it may be more economical to admit the water, thus getting the advantage of the back pressure, and remove the remainder by dredges, which will then be available and which can be passed through the locks when completed. This will be done if need be, but in any event there is nothing that can be foreseen at present which will postpone the date fixed for the official opening, with ample time to spare for tuning up the operating machinery and to organize and train a force for the operation and maintenance of the canal by January 1, 1915.

With concrete work in the locks coming to a close in the early part of 1912, steps must be taken to disband the present organization. The time has arrived for outlining an organization for the operation and maintenance of the canal. The tuning up of the machinery and the training of an organization will require the actual use of the canal. It is stated on reliable authority that at least 18 months will be required for shipping to adjust itself to the new conditions that will exist when the canal is ready for use. Such readjustment, however, will not be attempted until some definite announcement is made of the tolls that are to be charged and the basis for such tolls.

THE CANAL IS WORTH THE $375,000,000 INVESTED

Much has been said and predicted as to the commercial value of the canal to the United States. In this connection it must be remembered that the commercial shipping of this country never required the canal. The trip of the Oregon in 1898 settled the question of the advisability of constructing an Isthmian Canal, and had the canal been built at that time, thereby saving that trip around the Horn, there is no question that it would have been agreed generally that the canal, even at an expenditure of $375,000,000, was worth while.

In whatever light the Panama Canal is viewed, it will have paid for itself if in time of war or threatened war a concentration of the fleet is effected without that long, tedious, uncertain route followed by the Oregon.

It will practically double the efficiency of the fleet, and, notwithstanding the fact that we are a peaceful nation, our outlying possessions make the Panama Canal a military necessity, and it must be so recognized. From this point of view the debt should be charged to the account which necessitated its construction, and whatever revenues are derived from other sources are so much to the good. The traffic that will utilize the canal depends upon the tolls that will be charged, and the President has asked the Congress for legislation which will enable the establishment of rates.

There is another policy which if adopted will have a material bearing on the revenues of the enterprise. Through the Panama Railroad a large expenditure of money has been made for providing the present working forces with supplies of all kinds. Though the railroad has been reimbursed for this plant through fixed charges on sales, it should not be abandoned, but utilized for furnishing shipping with its needed supplies. Suitable coaling plants should be erected for the sale of coal to vessels touching at or passing through the canal. In addition, since oil is now used on a number of ships plying in the Pacific, such fuel should also be on hand for sale by the canal authorities.

The extensive machine shops now located at Gorgona must be moved before the completion of the canal, and they should be established in connection with a dry dock that will be needed for commercial purposes, and utilized as a revenue producer for the canal. This policy also needs congressional action.

With properly regulated tolls, and with facilities for fully equipping, supplying, and repairing ships, the Panama route would offer many advantages and bring to it a sufficiently remunerative return to pay not only the operating expenses, but to gradually absorb the debt which the United States has incurred by its construction.

THE NATIONAL GEOGRAPHIC SOCIETY

THE speeches delivered before the National Geographic Society on the occasion of the annual banquet, Saturday evening, January 14, will be printed in full in the next number of the Magazine.

At the annual meeting of the Society, January 13, the eight members of the Board of Managers whose terms expired at the meeting were unanimously re-elected for the ensuing three years, viz., Alexander Graham Bell, Henry Gannett, J. Howard Gore, A. W. Greely, Gilbert H. Grosvenor, George Otis Smith, O. H. Tittmann, and John M. Wilson.

At a regular meeting of the Board of Managers, January 18, Mr. Henry Gannett was re-elected President; Mr. O. H. Tittmann, Vice-President; Mr. O. P. Austin, Secretary, and Mr. John Joy Edson, Treasurer, for the ensuing year. The reports of the Secretary and Treasurer for the year 1910 are printed below.

REPORT OF SECRETARY O. P. AUSTIN FOR THE YEAR ENDING DECEMBER 31, 1910

The year 1910 shows a large increase in the membership of the National Geographic Society and a general improvement in its condition and work.

The number of members December 1, 1909, was 53,333; the number added upon their own application during January 1-December 31, 1910, was 23,398; the losses by death, by resignation, and by non-payment of dues was 2,703, making the total membership on December 31, 1910, 74,018. Fifty-one new life members were elected during the year, making the total life membership 399.

The membership is distributed throughout all the States and Territories of the Union, and includes about 2,358 in the District of Columbia, and between 700 and 800 in the Philippines, Hawaii, Porto Rico, and Alaska. The membership in foreign countries is 2,404, and

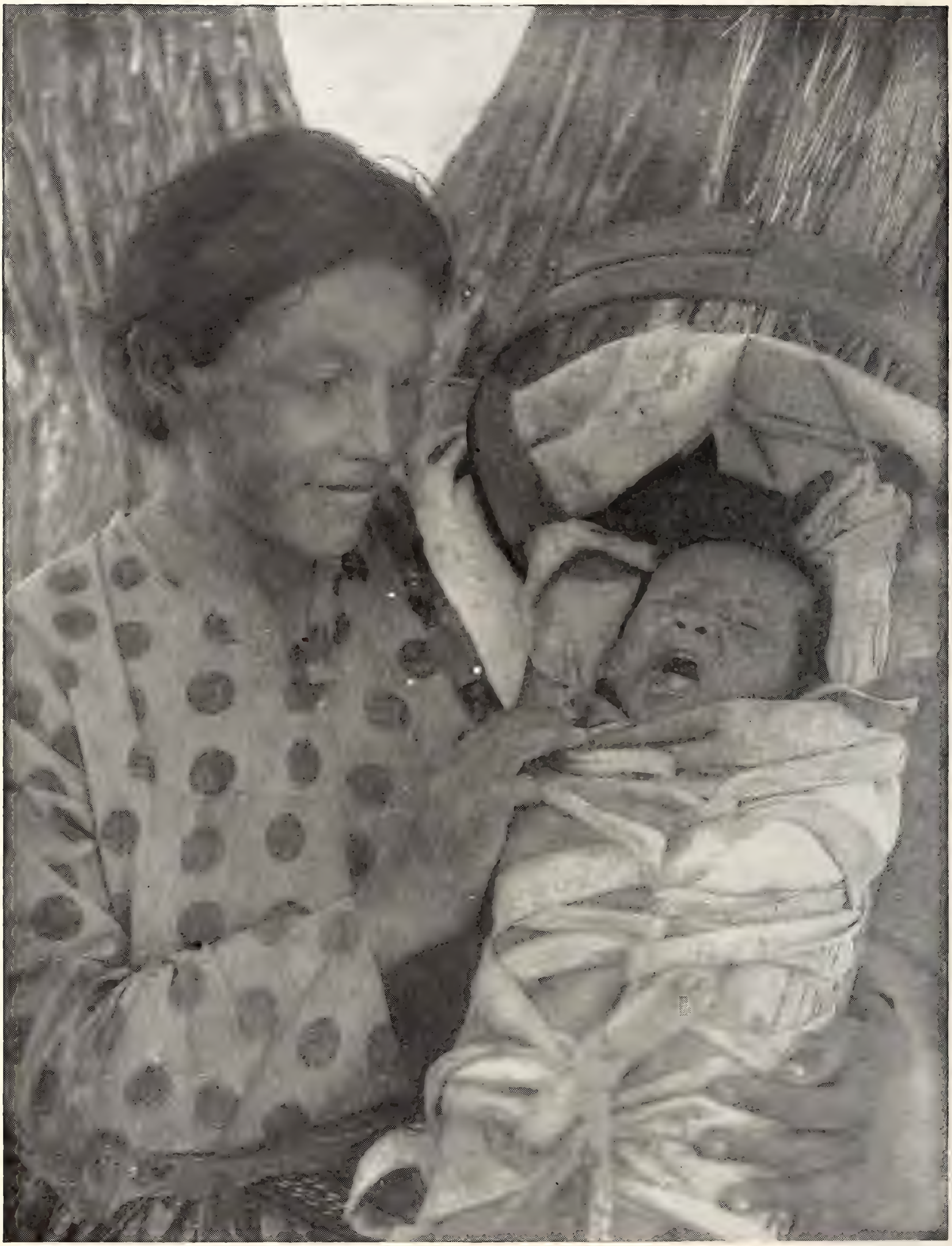


Photo by P. G. Gates, of Pasadena, California

NAVAHO WOMAN AND BABY

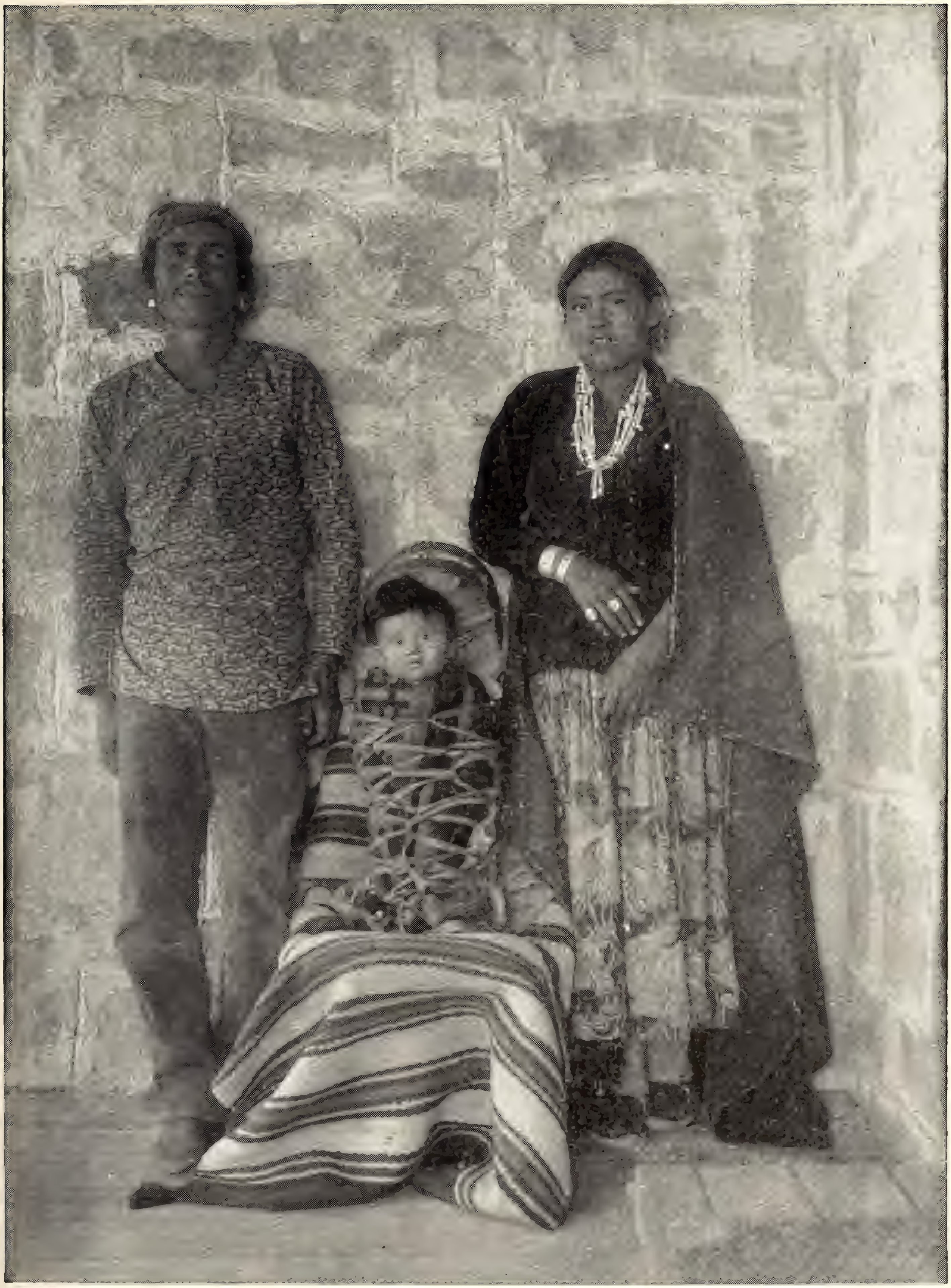


Photo by P. G. Gates, of Pasadena, California

NAVAHO FAMILY OF ARIZONA

represents fifty different countries and colonies of the world, including all the European countries, Egypt, India, China, Japan, Australia, New Zealand, the various Central and South American countries, and several of the West Indian islands. The membership in Canada is 863; in Mexico, 450; in Cuba, 116; in Panama, 183; in Europe, 652, and in Central and South America, 129.

A gold medal was presented March 26, 1910, to Sir Ernest H. Shackleton for his explorations in the far south, the presentation being made on behalf of the Society by the President of the United States, William H. Taft. On November 18 ex-President Roosevelt addressed the Society on his recent expedition to Africa.

Honorable William H. Taft was elected an honorary member of the Society during the year in recognition of his active interest in the promotion of geographic science. The Society now has five honorary members, as follows: William H. Taft, Theodore Roosevelt, Robert E. Peary, George Dewey, and Frithjof Nansen.

REPORT OF TREASURER JOHN JOY EDSON FOR THE YEAR ENDING DEC. 31, 1910

Receipts:		
Cash balance, as shown by statement of December 31, 1909	$10,614.55	
Dues	120,442.16	
Life members	2,550.00	
Magazine—subscriptions and sales	11,504.93	
Lectures	7,324.55	
Advertising	15,403.28	
Interest on investments and on bank deposit	1,826.77	
Publications	8,567.62	
Notes paid	12,000.00	
Sundry	1,244.12	
		$191,477.98
Disbursements:		
Salaries and services	$24,312.27	
Magazine—paper, printing, articles, etc.	70,166.04	
Magazine—pound rate postage	4,700.00	
Postage	8,018.59	
Printing and stationery	10,999.25	
Lectures	7,215.73	
Hubbard Memorial Hall—lights, heat, telephone, furniture, etc.	1,053.03	
Publications	867.89	
Research Committee (Alaskan Expedition)	5,141.08	
Advertising commissions	711.17	
Taxes, all of 1910	298.17	
Medals	675.00	
Remodeling and repairs to No. 1152 16th street N. W.	943.42	
Purchase of lots 46 and 47, square 183, 57 feet on 16th Street N. W., adjoining present property of Society	32,021.22	
Sundry	2,164.97	
Cash on deposit in the Washington Loan and Trust Co	22,190.15	
		$191,477.98

ASSETS DECEMBER 31, 1910

Notes, secured by first deeds of trust on real estate	$18,500.00
Publications on hand, at cost	3,500.00
Real estate:	
Lot 45, square 183, purchase price	11,338.95
Lot 46, square 183, purchase price	16,145.22
Lot 47, square 183, purchase price	15,876.00
Cash in the Washington Loan and Trust Co	22,190.15
Assets December 31, 1910	$87,550.32
Assets December 31, 1909	59,453.50
Gain in assets, 1910	$28,096.82

VOL. XXII, NO. 3 WASHINGTON MARCH, 1911

THE NATIONAL GEOGRAPHIC MAGAZINE

FIELD SPORTS AMONG THE WILD MEN OF NORTHERN LUZON

By DEAN C. WORCESTER

SECRETARY OF THE INTERIOR OF THE PHILIPPINE ISLANDS

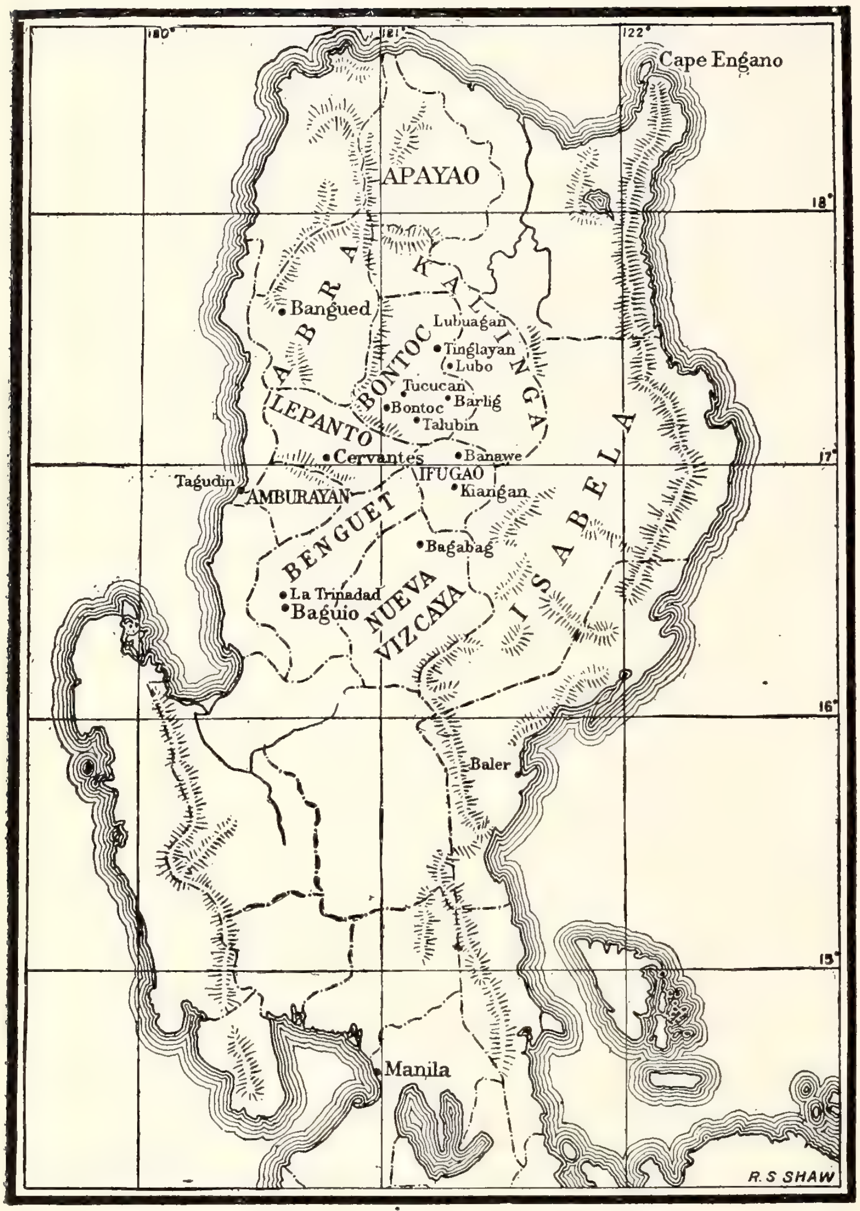
With Photographs by the Author

MY acquaintance with the wild men of northern Luzon began in July, 1900, shortly after the arrival of the second Philippine Commission at Manila.

We now know that there are but seven non-Christian tribes in northern Luzon, namely, the Negritos, the Benguet-Lepanto Igorots, the Ilongots or Ibilaos, the Ifugaos, the Bontoc Igorots, the Kalingas, and the Tingians; but at that time no member of the Philippine Commission had any personal familiarity with the tribes of this region. My own previous travels had been limited to Marinduque, Mindoro, the Visayan Islands, Mindanao, and the Sulu, Tawi-Tawi, and Palawan groups. No other Commissioner had ever previously visited the Philippines. I was therefore forced to get my information concerning the non-Christian people of northern Luzon from the available literature, which was full of contradictions and obvious misstatements.

For instance, Fernando Blumentritt, whose extraordinarily incorrect statements relative to the non-Christian people of this region had at that time hardly been questioned, assigned to it a total of some 36 tribes, while the Jesuit priests at Manila, following Blumentritt for the most part, gave a total of 26.

In the general scheme of government for the Philippines, the control of all non-Christian tribes, except those of the Moro province, was assigned to the Secretary of the Interior. It also fell to my lot to draft such legislation as might be deemed necessary in the premises; and, in order that I might do this with an adequate knowledge of the facts and might exercise intelligently the somewhat arbitrary authority vested in me by law, it seemed to me necessary to visit the wild man at home, and to investigate conditions on the ground. I therefore began a series of trips which were at first limited to the territory over which the Spaniards had established some semblance of authority, but were gradually extended to previously unknown regions until I had familiarized myself with conditions throughout practically all of northern Luzon.



SKETCH MAP OF NORTHERN LUZON

These trips were at first made at my own discretion, but later the provinces largely populated by non-Christians were organized under the so-called Special Provincial Government Act, and the duty of visiting and inspecting each such province at least once during each fiscal year was imposed by law upon the Secretary of the Interior.

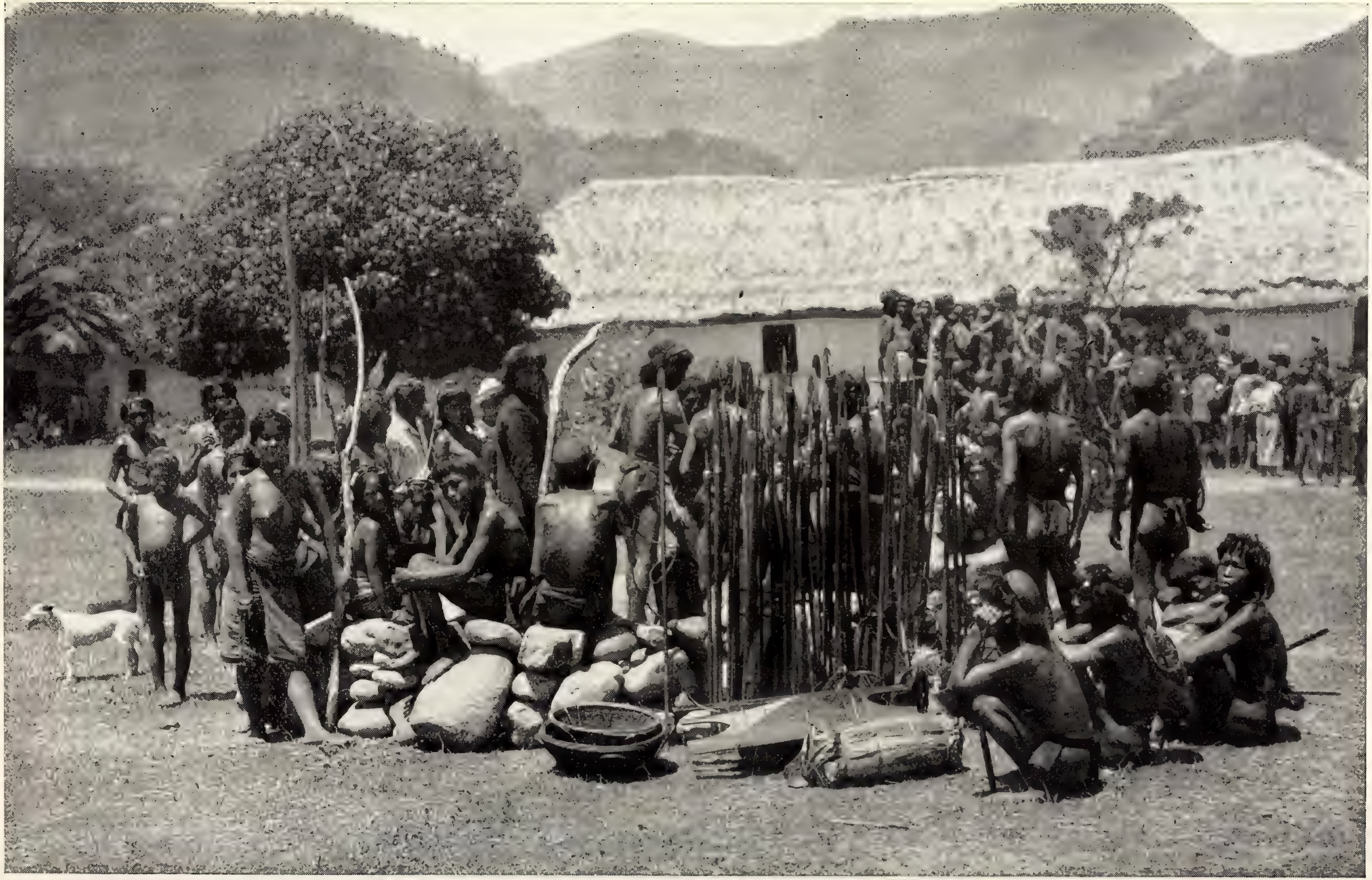
The number of wild men who assembled to meet me at important points was at first small, and the meetings held with them were very informal. The meetings are still informal, but the attendance now sometimes reaches 6,000 or 8,000. Opportunities are thus afforded to meet the headmen of entire subprovinces and amicably to discuss past occurrences and future plans. Gradually it has come to be understood that the feuds between hostile settlements must be forgotten at such gatherings. As a result there are often present delegations from settlements which have been fighting each other for years. When such people have once been brought into contact with each other it has often proved a comparatively simple matter to establish more or less permanent friendly relations between them.

It is obviously essential to maintain peace during the period of 24 to 48 hours while they are together. To do this and at the same time create just the right atmosphere to stimulate the frank and friendly discussion of any vexed questions which demand settlement, and the bringing about of friendly understandings between old enemies, requires no little tact and good judgment. On more than one occasion I have seen a thousand or more fighting men rush to arms and begin looking for trouble as the result of some occurrence which should have been of insignificant importance. Yet in the end good fortune has always attended us, and thus far no one has ever been killed, or wounded except by accident, while present at one of these gatherings.

NATIVES FOND OF INTOXICANTS

In achieving this very fortunate result, we have always been careful to see that there was plenty to eat *and not too much to drink!* The latter condition is not always easily maintained. Any one who knows the Christian Filipinos knows that the vice of alcoholism will never become common among them, but with the wild men the case is very different. Many of them are prone to overindulge in alcoholic stimulants; and, indeed, some of the tribes hardly considered it good form to leave a *fiesta* sober. At the outset the hillmen received the white man's firewater with enthusiasm and promptly got so drunk that the universe seemed to

AN IGOROT GATHERING LILIES NEAR THE TRAIL TO CERVANTES



IGOROTS FROM TUCUCAN VISITING AT THE TOWN OF BONTOC

The people of the latter place have recently taken a head from them, so, though they have come in to meet Secretary Worcester, they have brought their lances with them. Note the peculiar caps

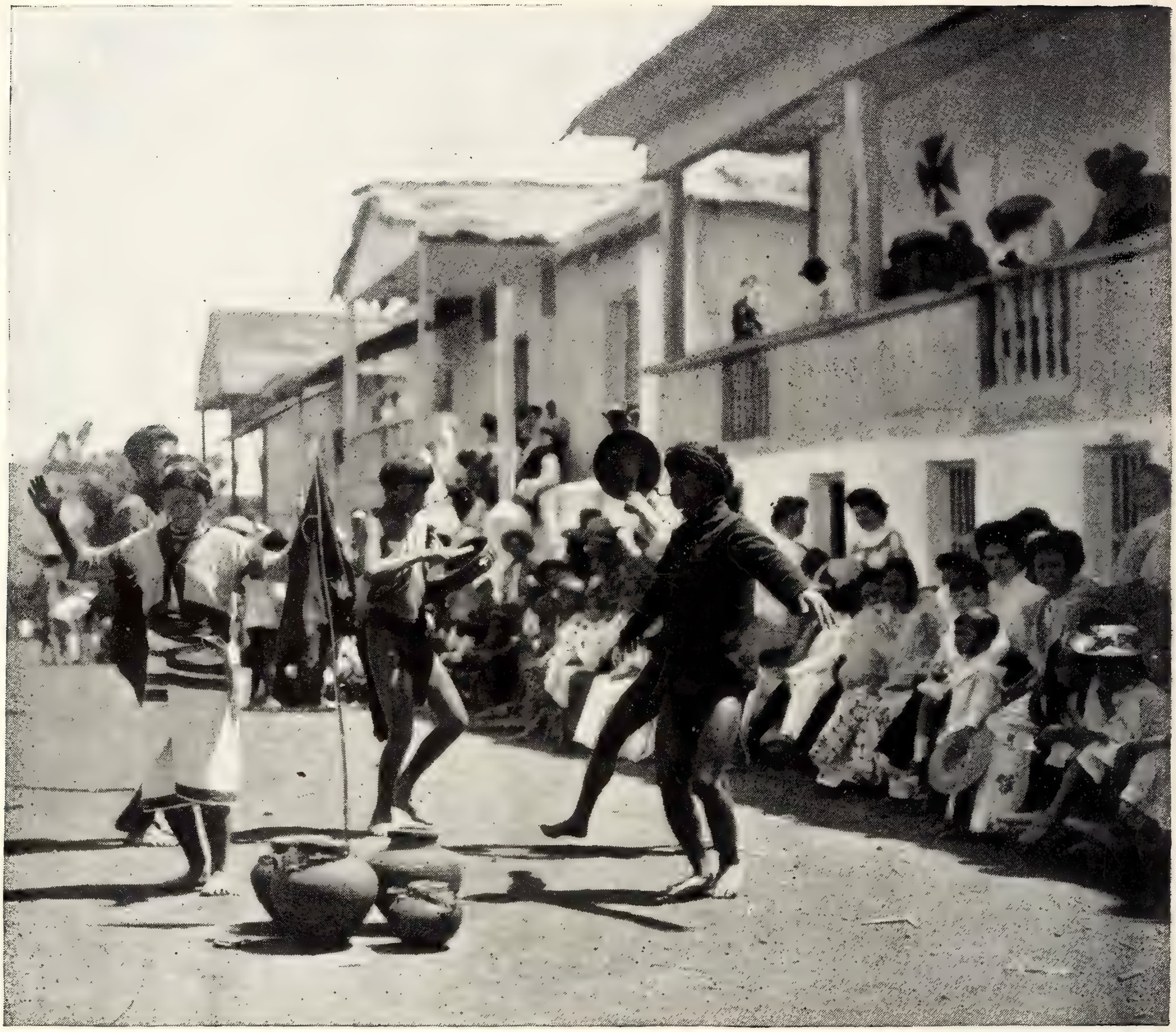
LEPANTO IGOROTS BRINGING IN TAPUY: CERVANTES

Tapuy is a fermented drink made from rice. The old jars, probably of Chinese origin, in which it is kept, are very highly prized

reel around them, and they had to hang on to the grass in order to lie on the ground.

I secured the passage of a stringent law, which is effectively enforced, making it a criminal offense to sell or give to any member of a non-Christian tribe "any ardent spirits, ale, beer, wine, or intoxicating liquors of any kind, other than the so-called native wines and liquors which the members of such tribes have been accustomed themselves to make."

The native drinks are comparatively mild and innocuous, but there are never lacking those who are willing to make up for their lack of strength by guzzling them in large quantity. Furthermore, to guard against a possible shortage, due to what they consider the Americano's ultra-conservative ideas, they are very apt to bring their own drink with them to these



LEPANTO IGOROTS AT CERVANTES

They are dancing around unopened jars of *tapuy* to propitiate the "anitos," or spirits of the dead, and make it certain that the drink will have a proper effect on those who partake of it. The spectators are Filipinos.

gatherings. Indeed, an absolutely essential feature of the arrival of a deputation of Ifugaos is that the headmen should offer *bubud* to the American officials. A refusal to taste it would be interpreted as an act of hostility, and would throw cold water on all subsequent proceedings.

KEEPING THE HEAD-HUNTERS IN GOOD HUMOR

Apart from the all-important question of providing proper food and drink, it is highly essential that from the time the first delegations begin to arrive until the last have departed the crowd should be kept occupied and entertained in order that there may be no opportunity for ill-disposed persons to stir up mischief. To this end the fondness of the hillmen for field sports has been utilized with constantly increasing success.

Members of six of the northern Luzon tribes—namely, the Ilongots, the Ifugaos, the Kalingas, the Bontoc Igorots, the uncivilized Tingians of Apayao, and the Negritos of the east coast of northern Luzon—have until recently followed that wildest and most dangerous of all such sports, in which the reward of success is a gory human head and the penalty

THE "BIRD" DANCE: CERVANTES (SEE PAGE 222)

for lack of skill and alertness is that one furnishes such a prize to some one else.

It may seem flippant to call head-hunting a field sport, yet the hard fact is that it has been just that with many of the northern Luzon hillmen. Furthermore, the game has often been played with close observance of very stringent rules, under which bodies of picked men from hostile rancherias met at prearranged times and places and fought to a finish. More commonly, however, attacks were made from ambush and victims were outnumbered ten to one by their assailants.

It is needless to say that this particular form of sport, with its attendant train of cowardly and ghastly murders of women and children and of endless bloody feuds, has not been smiled upon by the American authorities. The effort to suppress it has been unexpectedly successful and head-hunting is rapidly becoming a thing of the past, but superabundant animal spirits will inevitably find an outlet, and in this case we have tried, with a good deal of success, to direct them into less turbulent channels by teaching them American athletic games and by encouraging their fondness for dancing.

All hillmen and most hill-women love to dance, and each tribe has its own peculiar dances. Indeed, there are special dances which are confined to single settlements or small groups of settlements. Feasting, music, and dancing have gone together since the world was young, and we have frankly encouraged the continuance of this good old custom.

I invite you to take a trip with me, in imagination, through northern Luzon, in order that you may see for yourselves the part which field sports are playing among the wild people of that region.

We leave Manila on a coast-guard boat and 24 hours later land through the surf at Tagudin, the capital of the subprovince of Amburayan. As this is a Christian town, and as the wild men prefer to come to some point within their own territory to meet us, we have arranged that the Igorots of Amburayan should go to Cervantes, the capital of the neighboring subprovince, Lepanto.

Cervantes is reached after a horseback ride of 41 miles, in the course of which we climb upward through wonderful tropical forests until at the crest of the Malaya range we reach the pines and lilies of the temperate zone; we then descend its eastern slope, and as we approach our destination are met by a great gathering of Igorots on horseback and on foot, who escort us into town.

The plaza is already crowded and new delegations are constantly arriving, bringing with them their *tapuy,* a fermented drink made from rice. They are anxious to begin the *fiesta* and almost immediately open the *tapuy* jars and start the preliminary ceremonial dances necessary to insure the good-will of the spirits of the dead and to make it certain that the *tapuy* will have a proper effect on those who partake of it!

THE BIRD DANCE

Other dances of several kinds are soon in full swing. The commonest of these is the Benguet-Lepanto bird dance, the music for which is furnished by two long-barreled wooden drums with skin heads, two *gansas* or bronze timbrels, a stone, and a bit of iron and steel. Each drummer squats on the ground with the barrel of his drum held under his left arm. He beats its head with his open hands and gives considerable range to its really musical notes by fingering its head and by pressing on its barrel. The remaining musicians dance while they play. The *gansa* men beat their instruments with sticks, while the man with the steel and stone clicks them together.

The musicians dance around a circle of small diameter into which there presently steps a man with outstretched arms from which hang blankets reaching to the ground. He is supposed to represent a bird, and hops and swoops about in a peculiar fashion, occasionally letting his arms drop and walking by way of change. His advent is promptly followed by that of a woman, whose body is draped in a long blanket, which gives her much trouble by constantly slipping from her shoulders, often making it necessary for her to discontinue her dancing long enough to readjust it.

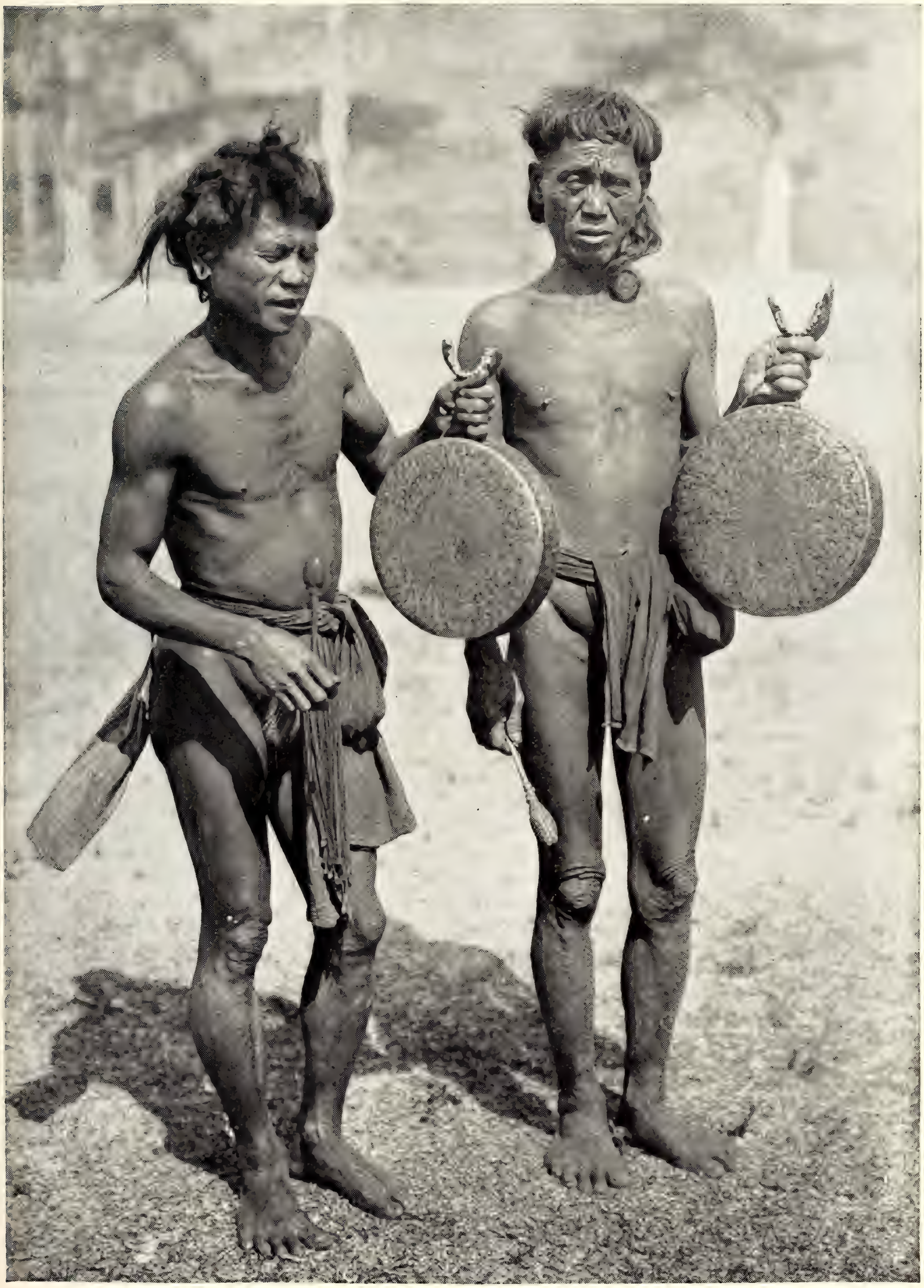
Her performance is usually stiff and ungraceful. All of the participants in the dance remain as solemn as if it were a religious ceremony.

The Lepanto Igorots also have a circle dance, which is invariably in evidence on festive occasions. Any number of persons of both sexes may take part in it. The men line up with their arms about each other's necks. The women form a similar line immediately back of them. The men sing and the women answer. The voices of the men are harsh and guttural. Those of the women are soft and musical. The lines soon begin to sway forward and back and then to move slowly to the right or to the left. The dancers sidestep and do a good deal of vigorous stamping. The two lines weave in and out, forming circles and straightening again, and the performance may continue for hours.

This circle dance is a much more cheerful performance than is the bird dance previously described. Shouts of laughter from the participants sometimes interrupt it. In the glare of the morning sun it looks prosaic enough, but when seen at night on some chilly, wind-swept hilltop, by the light of a blazing fire of pitch-pine, it becomes strangely attractive. One wishes that he could understand the words of the songs, which often obviously refer to him, but is forced to be content with watching the play of fire-light and shadow, listening to the strange harmonies of the barbaric music, and wondering what it is all about.

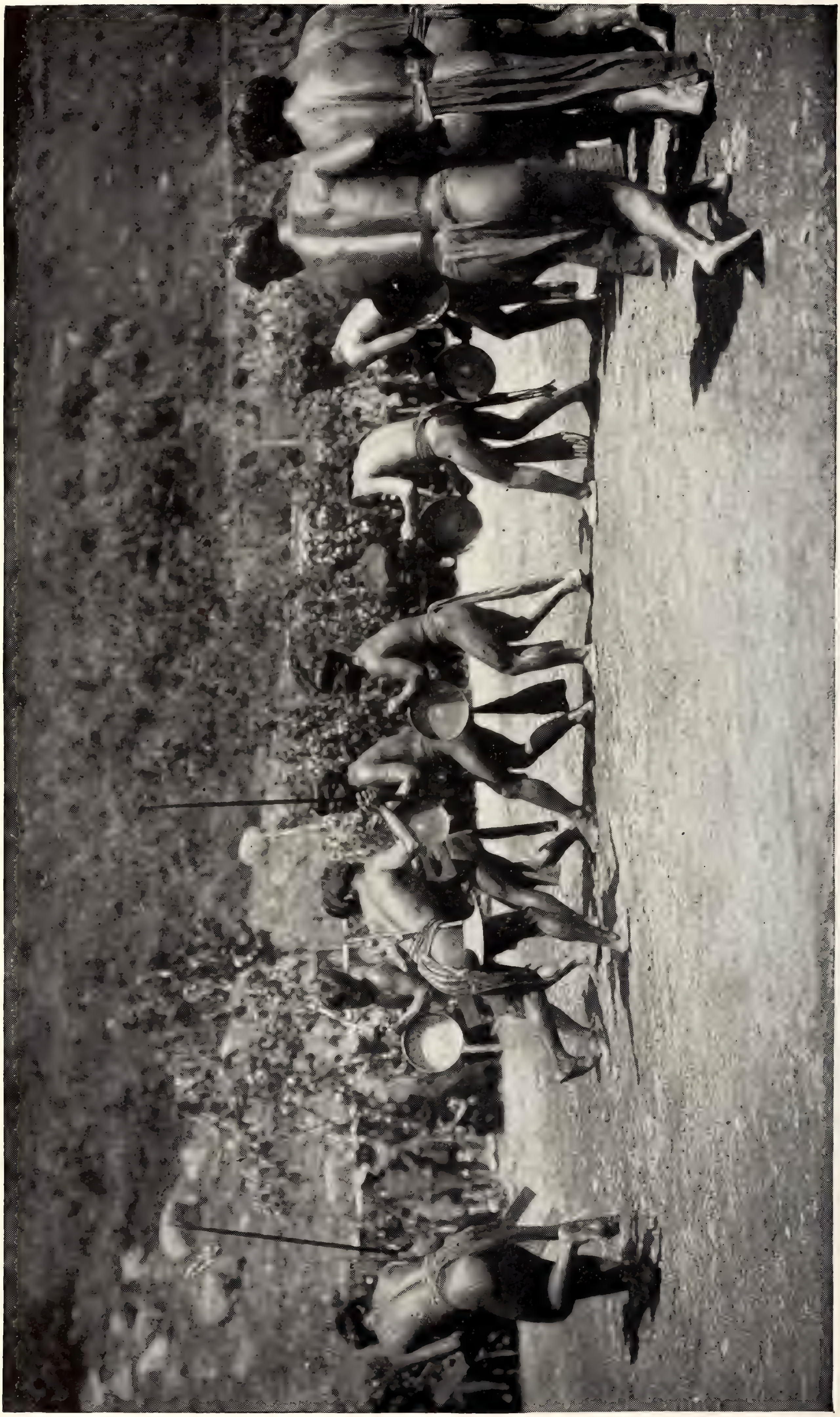
THE WILD DANCES OF BONTOC

Our next stop will be at Bontoc, 32 miles away, and for half that distance we climb steadily. As we leave Sagada, come out for a moment on the sky-line and begin the real descent to the Rio



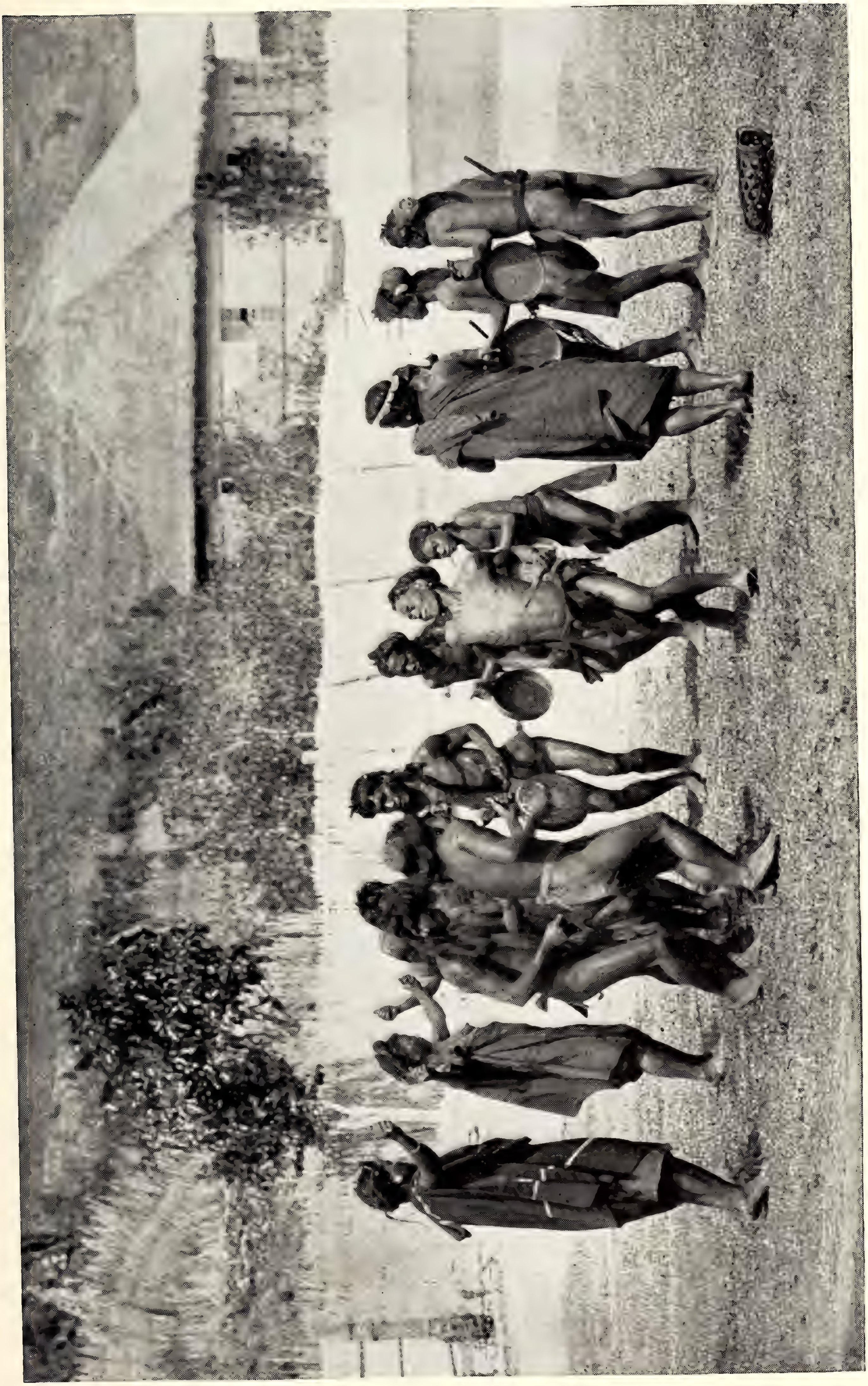
BONTOC IGOROTS WITH GANSAS

Note that the handles of the gansas are human lower jaws (see page 226)



BONTOC IGOROTS DANCING

“The men crouch slightly as they dance. Their steps are springing and panther-like” (see page 226)



A HEAD DANCE AT BONTOC

Note the contorted position of the man at the center. He is the principal actor

THE CHAMPION DANCER FROM BANGAD (SEE PAGE 232)

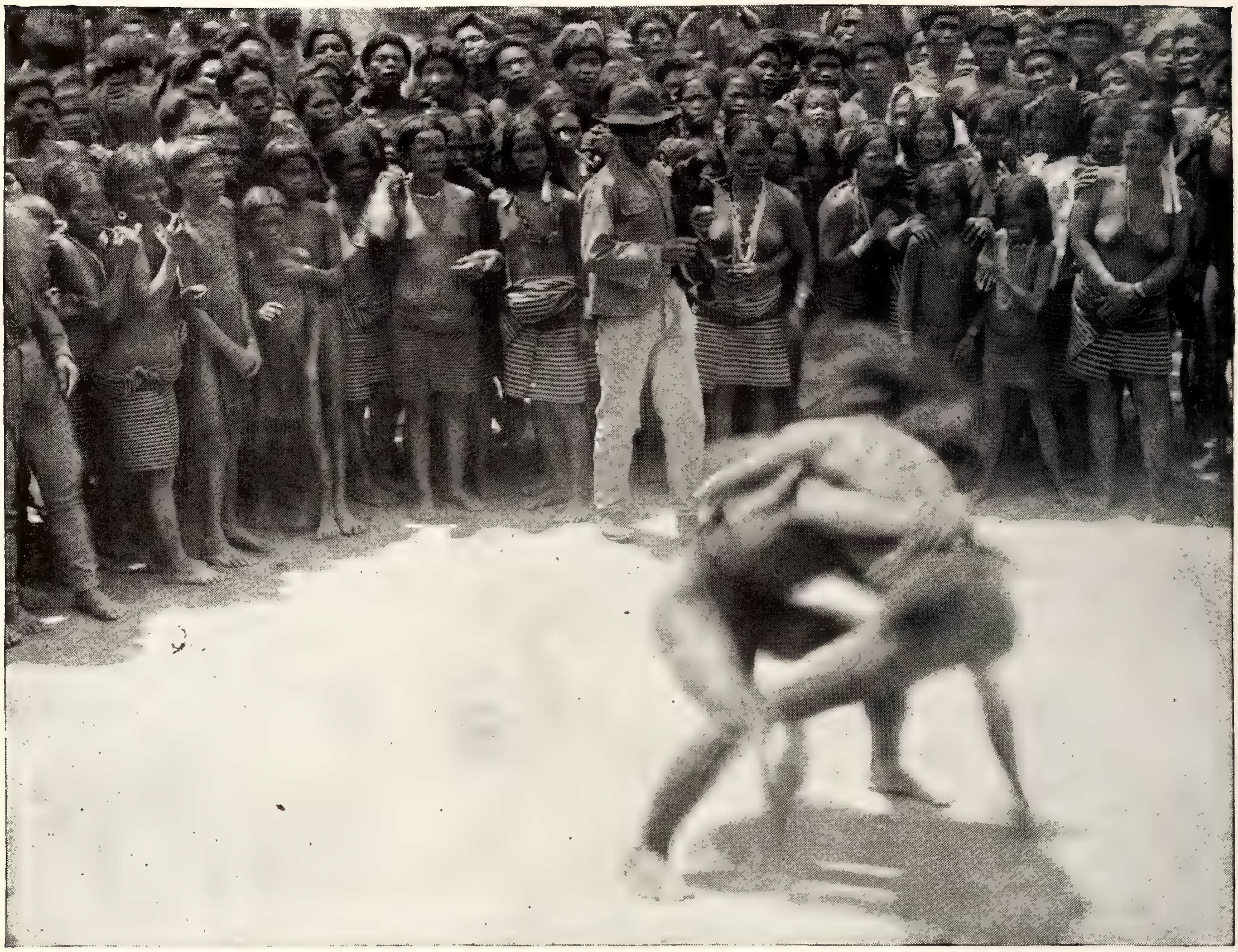
Chico near Bontoc, we catch, now and then, wind-borne musical notes, which rise and die away again and again, but gradually grow clearer. As we drop down a final bit of steep trail and come out on a flat-topped mountain shoulder, they swell out triumphantly, ringing harsh and clear, "díng-o, díng-o, ding-ding-díng-o" over and over again. There is nothing soft and soothing about this music. Its rhythm stirs one's pulse and one's toes in a strange fashion. The accompanying dance is a *man's* dance, danced by *men*. They move forward in single file. Each holds in his left hand a *gansa*, which he beats with a carefully fashioned skin-covered drumstick. The *gansa* handles are the lower jaw-bones of human enemies, slain no one knows how long ago (see pages 223-225).

The perfectly developed brown bodies of the dancers are naked save for handsome blue and scarlet clouts and an occasional boar's tusk arm ornament with its horse-hair plume. Not a man has an ounce of superfluous flesh. There is a beautiful rippling play of perfect muscles under clear skin. The men crouch slightly as they dance. Their steps are springing and panther-like. As they advance, pause, and retire, their alignment is never broken and their movements are executed in perfect time. Take a snap-shot at them with a fast camera, develop the plate, and you will find that the positions of the hands and feet of any given dancer correspond very closely with those of every other. This is our welcome to the land of the head-hunter. As we come abreast the dancers, they break ranks, crowd up to shake hands, and then fall in behind us.

An hour more and again we hear *gansa* music. A sharp turn in the trail brings into view a little level meadow just above the brawling waters of the Rio Chico. A mighty roar of sound greets us, the full-lunged cry of a thousand Bontoc Igorot headmen drawn up on the level ground in two lines facing each other, while half a dozen groups of dancers beat *gansas* and add to the deafening clamor. Here are gathered the best fighting men from every little town in the

THE WILD DANCERS AT BONTOC

This is the same girl as shown in the preceding picture



AN AMERICAN SUBSTITUTE FOR HEAD-HUNTING: A WRESTLING MATCH (SEE PAGE 232)

subprovince. They crowd up to shake hands with us as we dismount and pass between their lines.

They force upon us squawking chickens, produced from heaven knows where, and eggs, many of which are of undoubted antiquity. Fortunately we knew what we were going to get into, and a couple of boys with baskets receive these gifts of friendship from us after we have taken them from the hands of the donors, as official etiquette prescribes. As we mount our horses, again there comes a yell which makes our ear-drums vibrate like the blast of a big steam-whistle. The wild man likes to yell and he is good at it. We ride on into the town, followed by an apparently endless file of Igorots, marching to the music of *gansas* and occasionally giving a shout that wakes the distant echoes.

On entering the town we pass under a series of graceful arches which the friendly people have seemingly evolved out of nothing. We ride on to the plaza, where we are saluted by a company of Bontoc Igorot constabulary soldiers, armed with Krag carbines and uniformed in caps, coats, ammunition belts, and loin cloths. With them, trousers are "taboo." We ascend to the balcony of the provincial building. In ten minutes the plaza is one solid mass of black heads and natty, bright-colored rattan caps.

At one side we note that the crowd is pushing and scrambling. They are thirsty after the long march in the sun. Some one has brought out a great jar of *basi*, and the liquor is being handed around in small blue-enamel wash-basins, from which two or three men try to

THE END OF A WRESTLING BOUT

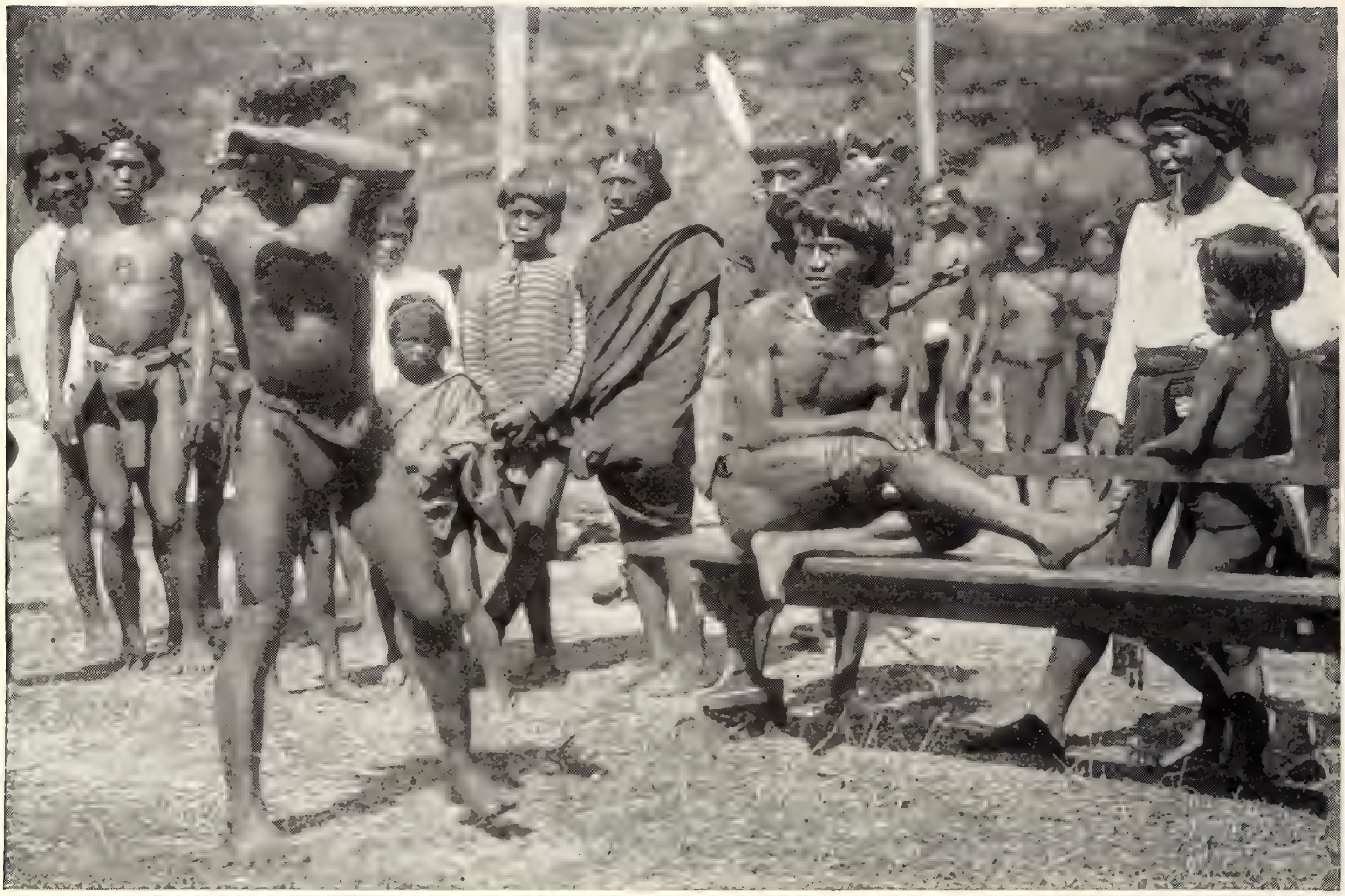
The judges and referee are Americans, and the Igorots have implicit confidence in the fairness of their decisions

drink at once. As a result half the *basi* is spilled on the ground, and no one gets much.

THE PICKED DANCERS OF BONTOC

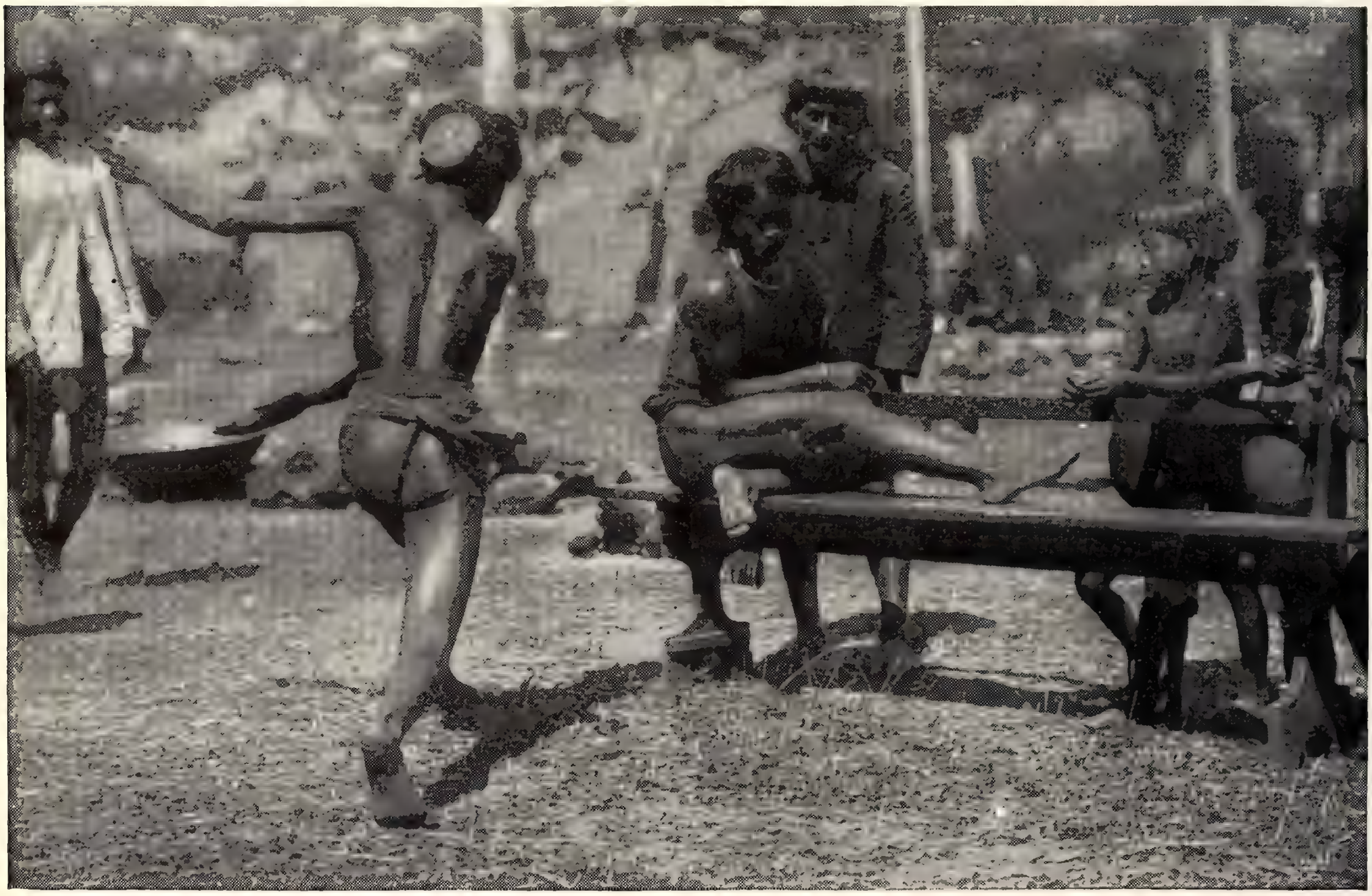
Now the *gansas* start up again. The crowd pushes back in all directions from a central point, and into the circle thus cleared step the picked dancers of Bontoc town, followed by a dozen of their women, each of whom wears a blanket draped from her left shoulder and under her right arm in such a way as to leave the right breast exposed. Music and dancing begin. It is the same dance that we saw beside the trail, save that the performers are now picked men, and that women are taking part. The latter dance with arms stretched horizontally from the shoulders, waving their hands in time to the music, at the same time rising on tip-toe and dropping down again, or lifting first one foot and then the other, either remaining in one place or moving forward or to one side very slowly. Their movements are more graceful than were those of the women whom we saw dancing at Cervantes, and many of them have wonderfully strong and well-developed bodies.

As things warm up, a famous fighting man, at the prime of life, steps lightly into the ring. The music changes a little and a real head-dance begins. Armed with head-axe alone, or perhaps with lance and shield in addition, the warrior

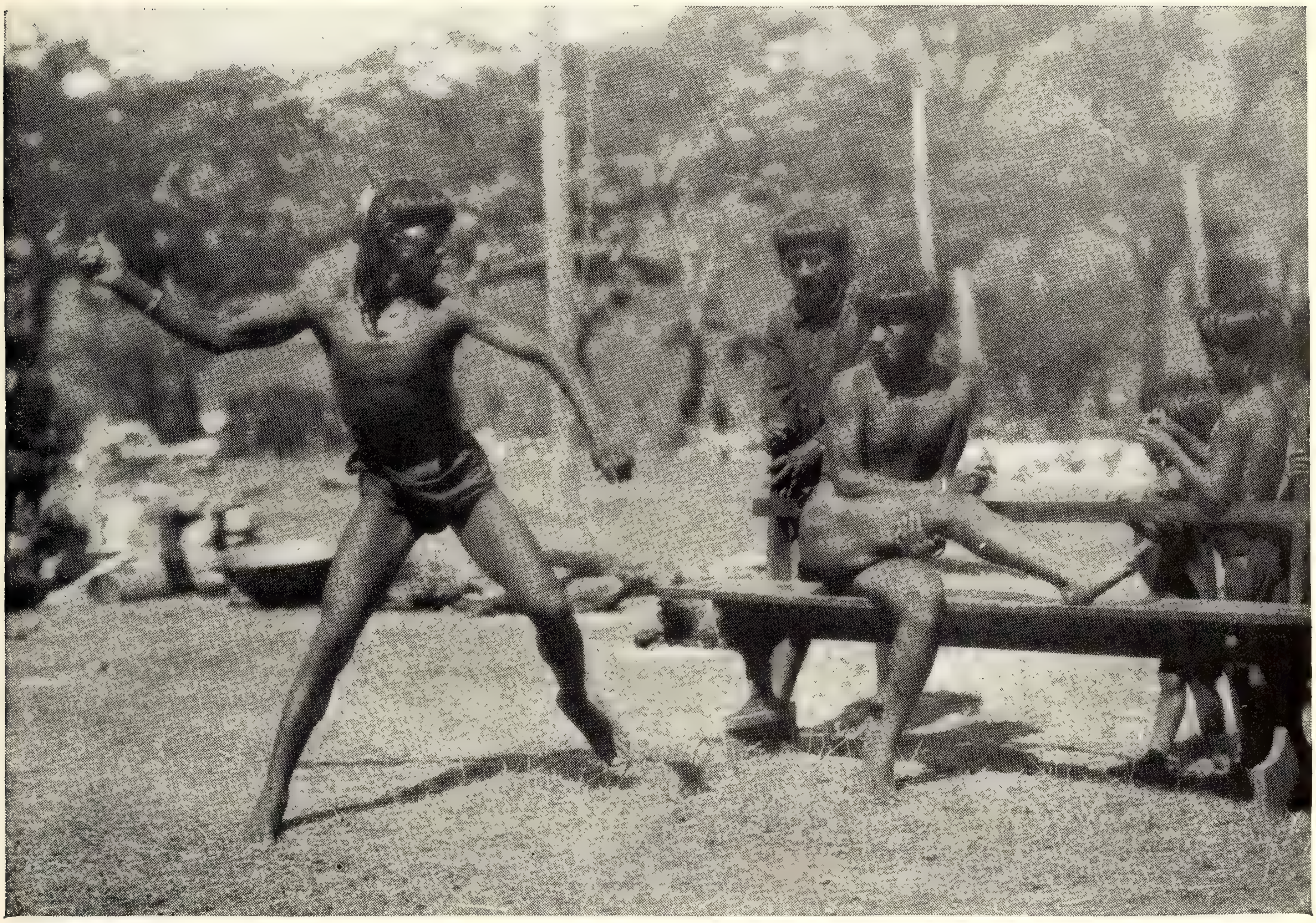


BONTOC IGOROT SLAPPING GAME

First position: striker ready to make his preliminary swing. The right arm is drawn behind as he swings on his right foot



Second position: the striker has just finished his preliminary swing (see page 233)



BONTOC IGOROT SLAPPING GAME

Third position: the striker ready to deliver his blow

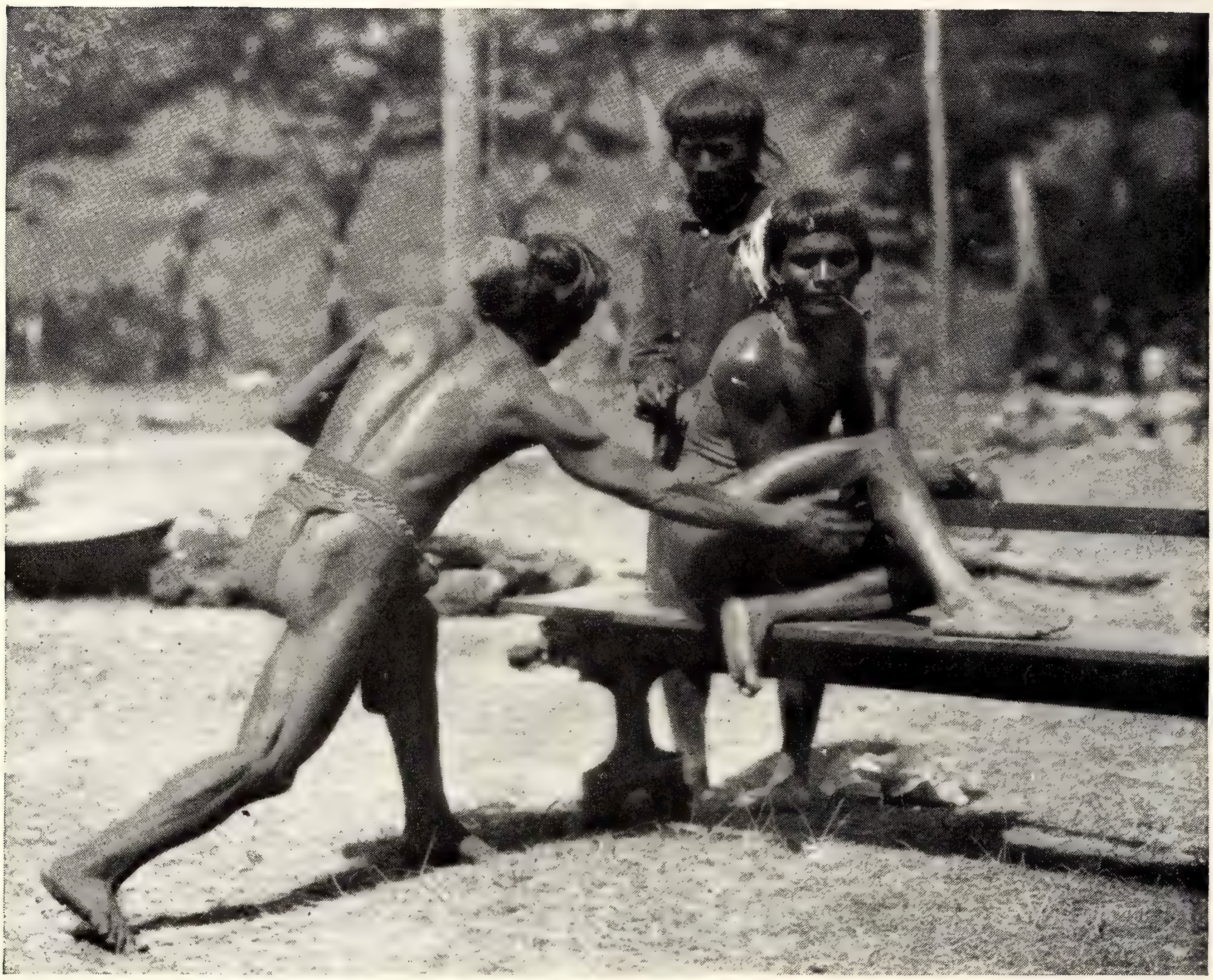
executes a pantomime, showing how he fought his enemy, killed him, and took his head. Meantime his feet never for a moment fail to keep time to the music. In two minutes we learn things about the handling of shield, lance, and head-axe of which we never dreamed. As the performance ends, the crowd indicates its appreciation by giving an ear-splitting yell. Those who have not been able to see the dancer nevertheless join in the applause on general principles.

The dancers from Bontoc town lay their *gansas* on the ground and retire, and a picked delegation of their ancestral enemies from the neighboring town of Tucucan snatch up the instruments and announce that they will show the people of Bontoc a little *real dancing*. This time two fully armed warriors indulge in mimic combat, advancing, retiring, thrusting, parrying, and keeping up a marvelous exhibition of skill and endurance, but withal never for an instant losing the step.

Town after town sends its dancers to the front, and each new delegation is generously applauded. This gives rise to good feeling, and presently the town lines, which were at the outset sharply drawn, begin to break down and people from two or more settlements dance together. The Igorot constabulary soldiers cannot resist the temptation to join in. At first they retain their uniforms, but soon get too warm, retire for a moment, and reappear stripped to their clouts. Their strikingly light-colored bodies show that the Bontoc Igorot, when free from dirt and sunburn, has quite a fair skin.

THE CHAMPION DANCER

We go down and mingle with the crowd, and, noting unusual excitement among the women at the edge of a dance circle, force our way through to



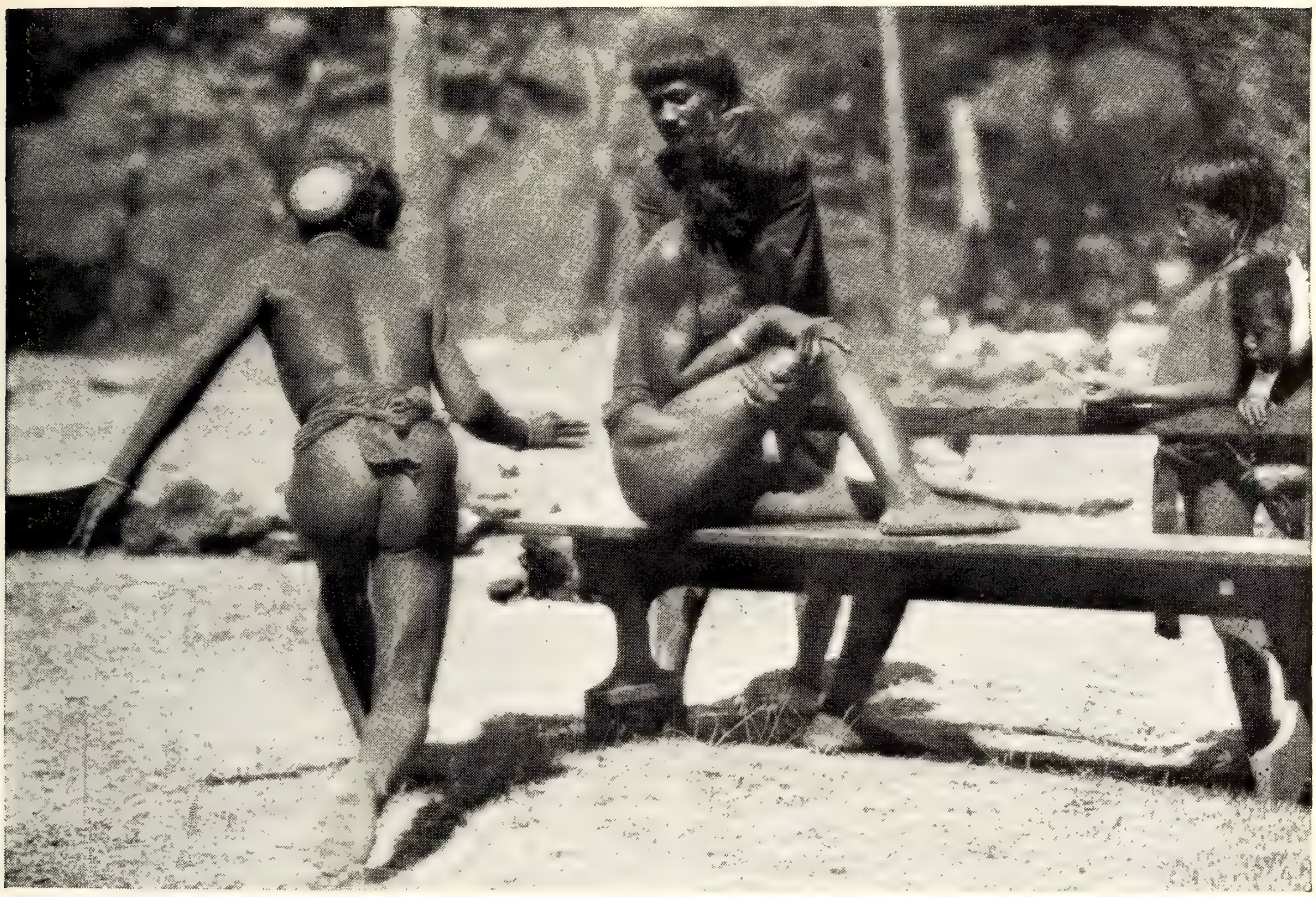
BONTOC IGOROT SLAPPING GAME

Fourth position: note the knots of muscle that spring out on the striker's arm, back, and legs as he strikes

ascertain its cause. We are well repaid for our trouble. The men from Bañgad, in the far north, have the floor. They have brought only one woman with them to uphold the reputation of their town, but she is abundantly capable of doing this. There is nothing slow about *her* dancing, nor does she bob up and down in one place like the Bontoc girls. She wears only a bright-colored and handsomely embroidered skirt, reaching from the waist to the knee and open up the right side, so that her movements are absolutely unimpeded. Her arms are stretched upward and outward, and her open hands are extended, palms up. Her chest is thrown out and her shoulders are held well back. Her arms and hands convey the impression of soaring wings, and she seems hardly to touch the ground. While the dance lasts she has no thought for anything else. When it ends and the crowd shrieks its approval, she becomes self-conscious, covers her face with her hands, and bounds away like a deer.

A WRESTLING MATCH

Now, with much pushing and jabbering, a larger ring is cleared. The towns of Tinglayan and Tucucan have had a difference of opinion over a stolen hog. They are to settle the matter by a wrestling match, instead of by fighting it out, as they would have done a few years ago. The two champions come forward and look each other over. Each reaches his arms behind the other and takes a



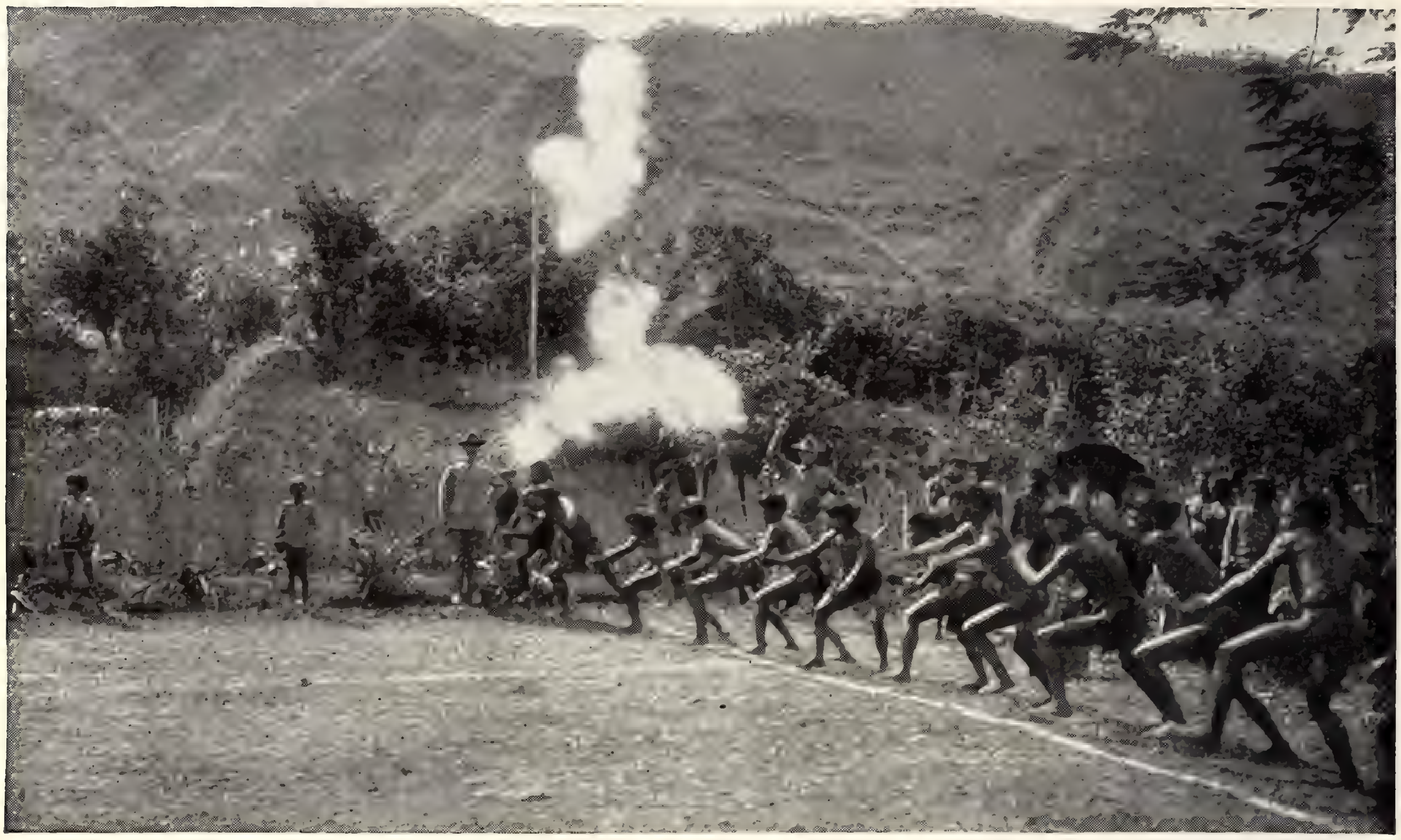
BONTOC IGOROT SLAPPING GAME

Fifth position: just after the blow. The man struck does not look happy

firm grip on the waistband of his opponent's clout. There is an instant of quiet, and then begins a curious hauling and tugging as each strives to lift the other bodily from the ground and throw him flat. Tripping is barred. The physical exertion involved is tremendous and the bout is almost always short. A single fall may decide the match, or it may be the best two in three. The judges and referee are Americans, and the Igorots have implicit confidence in the fairness of their decisions.

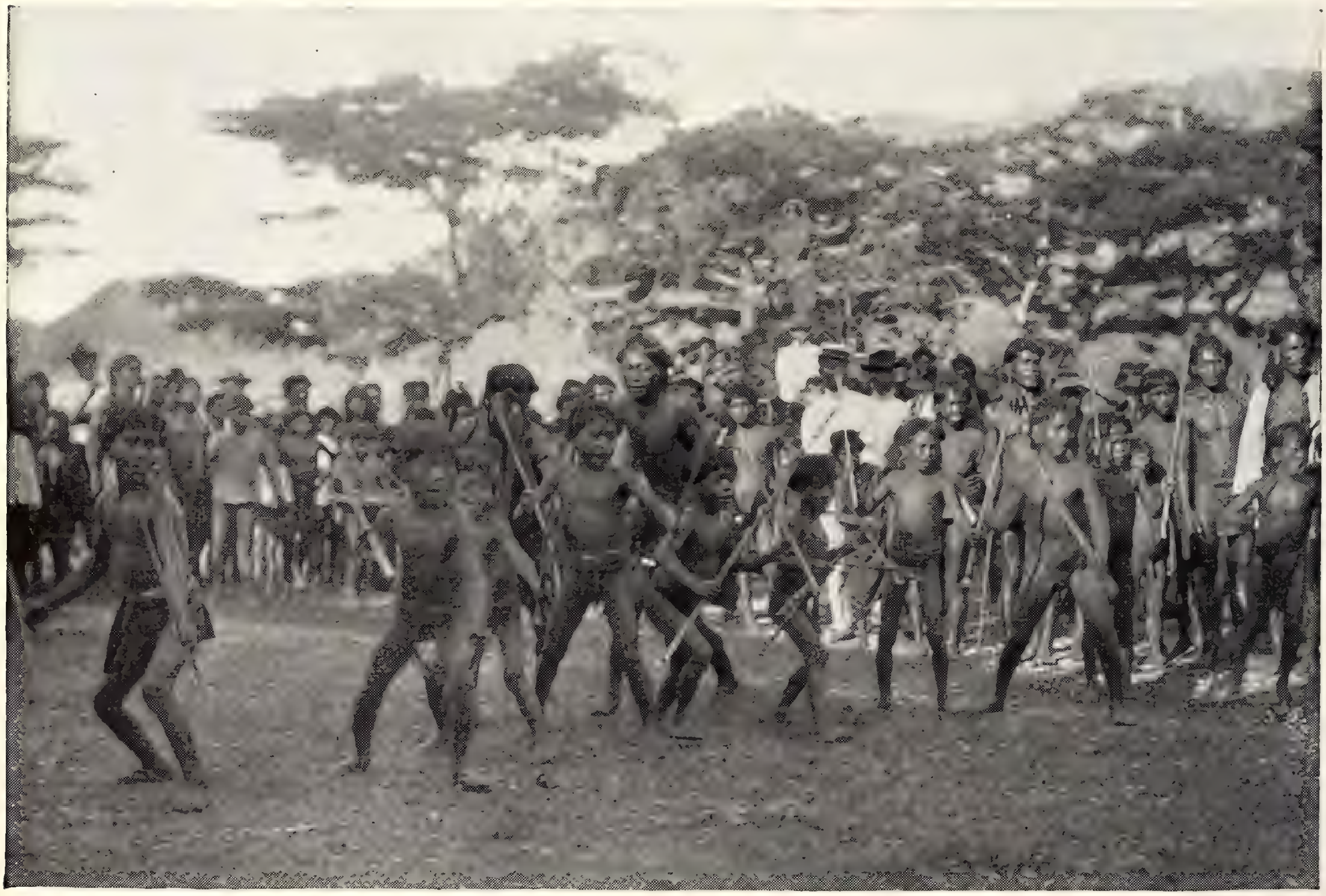
THE IGOROT SLAPPING GAME

A constabulary officer tells us that if we want to see a unique contest we must ask for the slapping game of the Bontoc Igorots from the towns of Kadaklan and Barlig. We want to see all there is going, and say so. A wooden bench is brought out and two lithe and muscular young men step forward. One of them squats on the bench, grasping his right thigh so as to tighten the muscles in a fashion which will be best understood from the accompanying illustrations. The other stands beside him and stretches out his right arm. He first throws it back and then sweeps it forward in a full round-arm swing. The blow falls on thin air close to the tightened thigh muscles of his opponent. He now swings his arm back again, his whole body turning with it, rises on the toes of his left foot, and puts every ounce of strength which he possesses into a stroke delivered with the flat of his hand full upon the rigid thigh of his opponent. Knots of muscle spring out on his arm, back, and legs as he strikes, and the blow cracks like a revolver shot. The recipient endeavors, sometimes with rather poor success, to preserve an expression of contemptuous indifference. The judges examine his thigh. If the blow has been hard enough, blood will show just beneath the skin, and he will



SUBSTITUTES FOR HEAD-HUNTING: THE START OF A BONTOC IGOROT MEN'S FOOT-RACE

"There is no beating the pistol at the start, no tripping or holding, 'no pocketing'"



A "WAR PARTY" OF BONTOC IGOROT BOYS THROWING RUNO STEMS AT ANOTHER PARTY

Note the men coaching them

A MEN'S THREE-LEGGED RACE

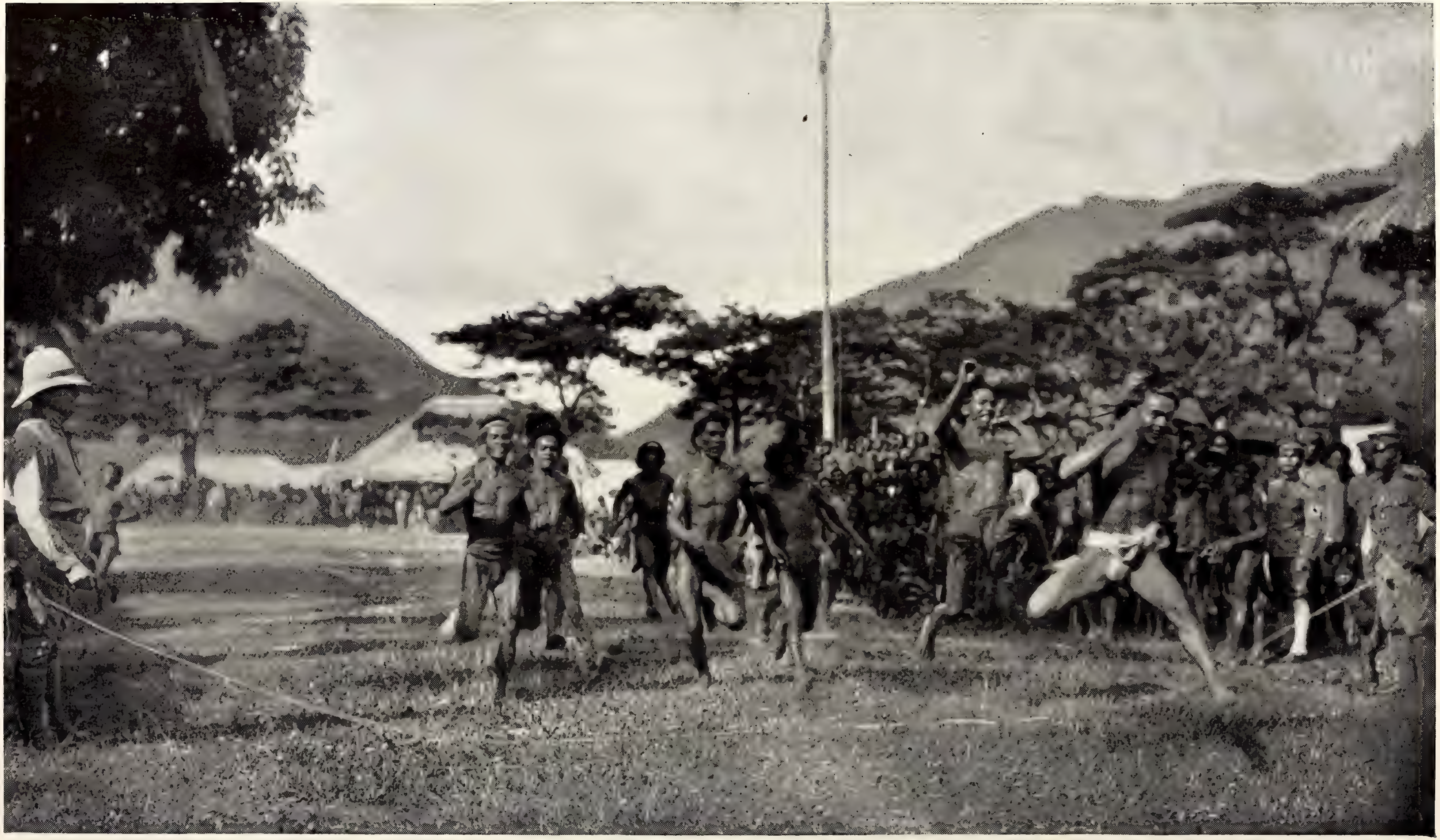
not have the satisfaction of taking a whack at his opponent; but, if this result has not been achieved, his opponent must take his place on the bench and be smitten. The contest continues until one succeeds in producing the bloody mark on the other.

RACES FOR ALL

There follows lance-throwing at a target. The crowd always takes great interest in this contest, vigorously applauding the more skillful contestants and mercilessly jeering those who throw badly.

The Igorot has now pretty well exhausted the list of his native sports, but he has been quick to learn from the Americans, and there is still much fun in store for him and us. A half dozen unarmed constabulary soldiers appear with a long rope. After much pushing and pulling they succeed in forcing the crowd back with it, and thus clear a track for short foot-races. There follow in quick succession a *presidentes'* race, a *vice-presidentes'* race, a race for picked men from the different towns, a men's three-legged race, and a free-for-all race for women. There is no lack of contestants. Indeed, it is difficult to keep the number down to the limits imposed by the width of the track. The innate sportsmanship of these hillmen comes out very clearly in running contests. There is no beating the pistol at the start, no tripping or holding, no "pocketing," no dirty work of any sort. The competition is both clean and good-natured. The prize may be anything from a flannel shirt or a woolen blanket to the honor to one's town. The winners are happy and the losers are *good* losers.

The next event is a wheelbarrow race, which causes much merriment. The prize is a scarlet blanket hung on a stake at the end of the course, and he who



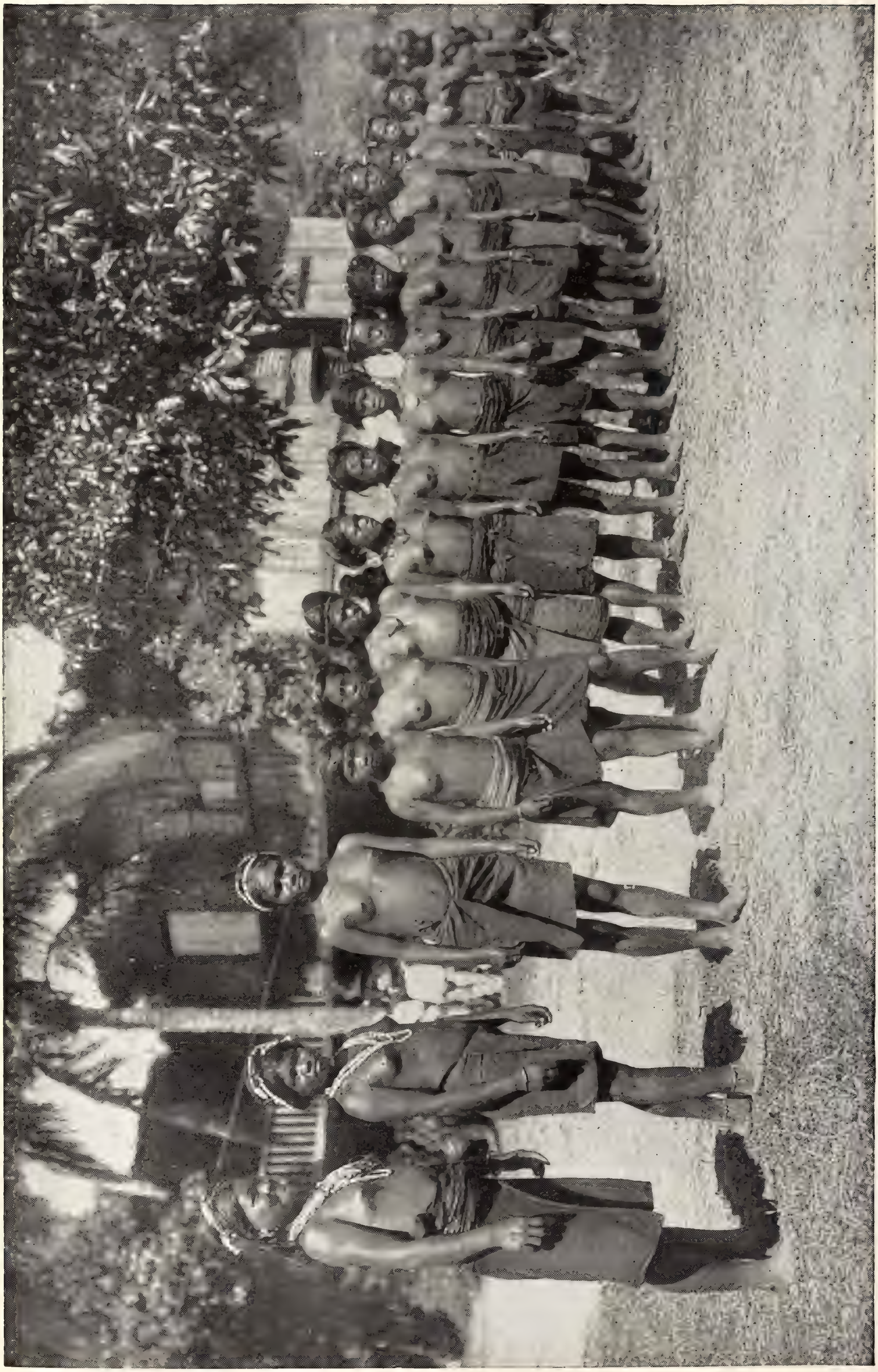
THE FINISH OF A BONTOC IGOROT MEN'S FOOT-RACE

A BONTOC IGOROT BOY WHO HAS BEEN BURROWING FOR COINS IN A DISH OF FLOUR (SEE PAGE 239)

gets it has it. There are four contestants. At the start one of them tips his barrow over and two others turn completely around. The fourth, through extraordinary skill or great good fortune, makes a straight run from the starting point to the stake, snatches the blanket, and disappears without once looking back. He is taking no chance of losing the prize!

THE GREASED-POLE CONTEST

Now comes the time-honored greased-pole climbing contest. In this case the "pole" is a *bamboo,* planted firmly in the ground and held in place with rattan guy-ropes. From a stick thrust into the top of the bamboo hangs a bag of coin. The wild man can climb like a monkey, and he hails this opportunity with delight, but there is a surprise in store for him. Bamboo in its natural state is smooth enough, but when it is thoroughly greased no living man can climb it. However, each new contestant wipes a little more of the grease off and goes a bit higher than his predecessor. Some climb with legs twisted around the bamboo; others use only their hands and feet.



BONTOC IGOROT GIRLS READY TO START IN A FOOT-RACE: THERE IS NO LACK OF CONTESTANTS IN ALL THE GAMES (SEE PAGE 235)

Eventually a smart constabulary soldier makes a try. When he reaches the hitherto unclimbed and consequently most slippery portion of the pole, he produces wood ashes from the waistband of his clout, and, holding on with his legs, proceeds to apply them. In this way he gets near the top; but at the last, when he can almost grab the bag, his strength gives out. Down he slides, slowly at first and then faster and faster, hitting the ground with a resounding thud, and shaking his burned hands as he goes off to renew his stock of ashes. Meanwhile a long-haired heathen from the north starts with a running jump, goes up the bamboo like a streak, and grabs the bag.

The small boy is not forgotten. He is allowed to bury his face in a wash-basin of flour and grope for coins, which, when found, must be seized in his mouth; or, he is blindfolded and hunts for dearly loved cans of salmon scattered on the ground. He forms war parties, which attack each other with runo stems in lieu of lances, and, in general, like the small boys of other countries, he makes a prodigious noise, gets in everybody's way, and has a wholly delightful time.

THE TUG-OF-WAR

And now comes the great event of the day. The wild man accepts with appreciation the American's greased-pole contests and wheelbarrow races, and grows enthusiastic over foot-races, but he has taken the tug-of-war to his bosom and made it his own.

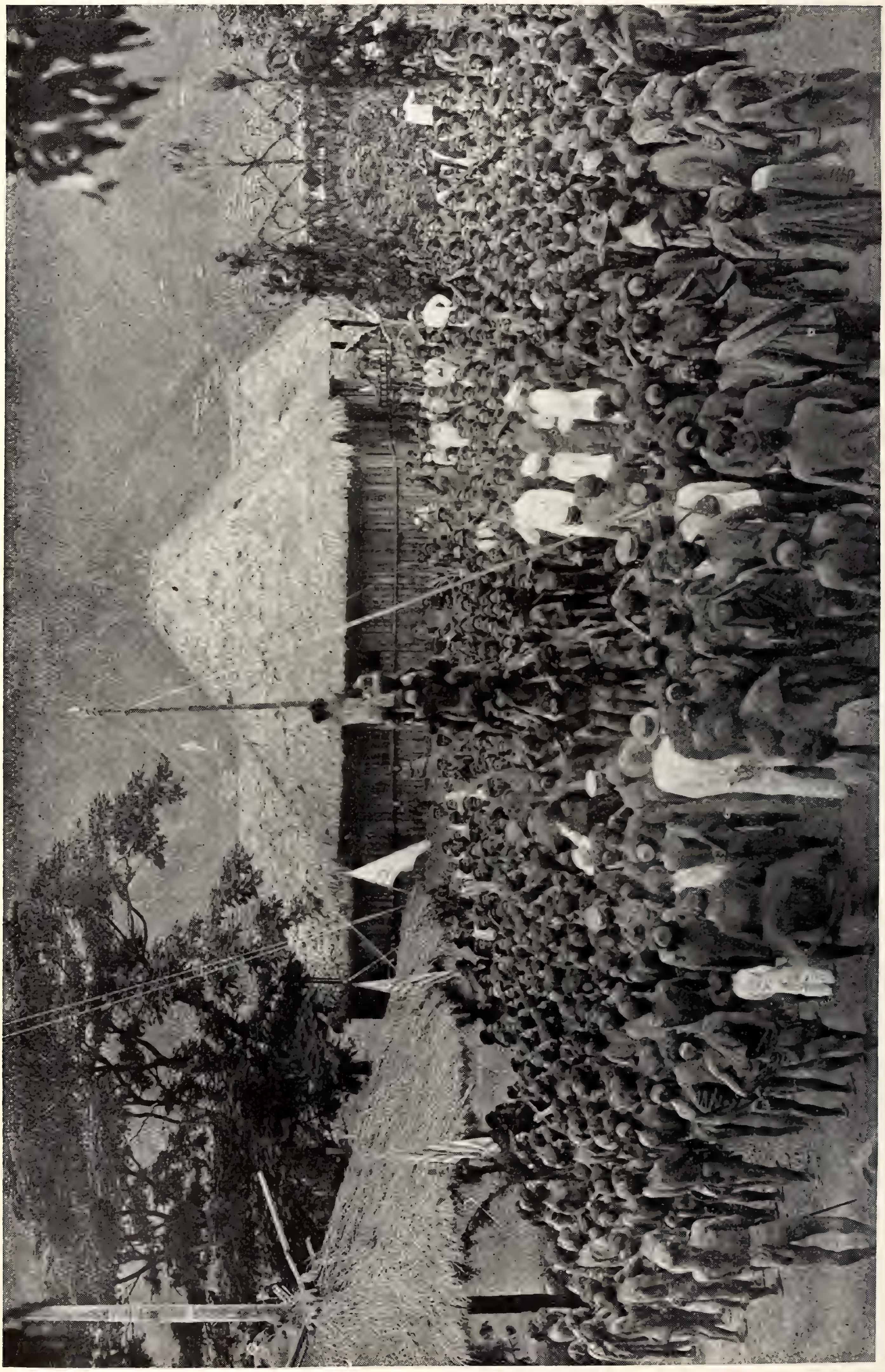
THE WINNERS OF THE GIRLS' FOOT-RACE

The girl on the left won first prize, the roll of cotton which she holds in her hands

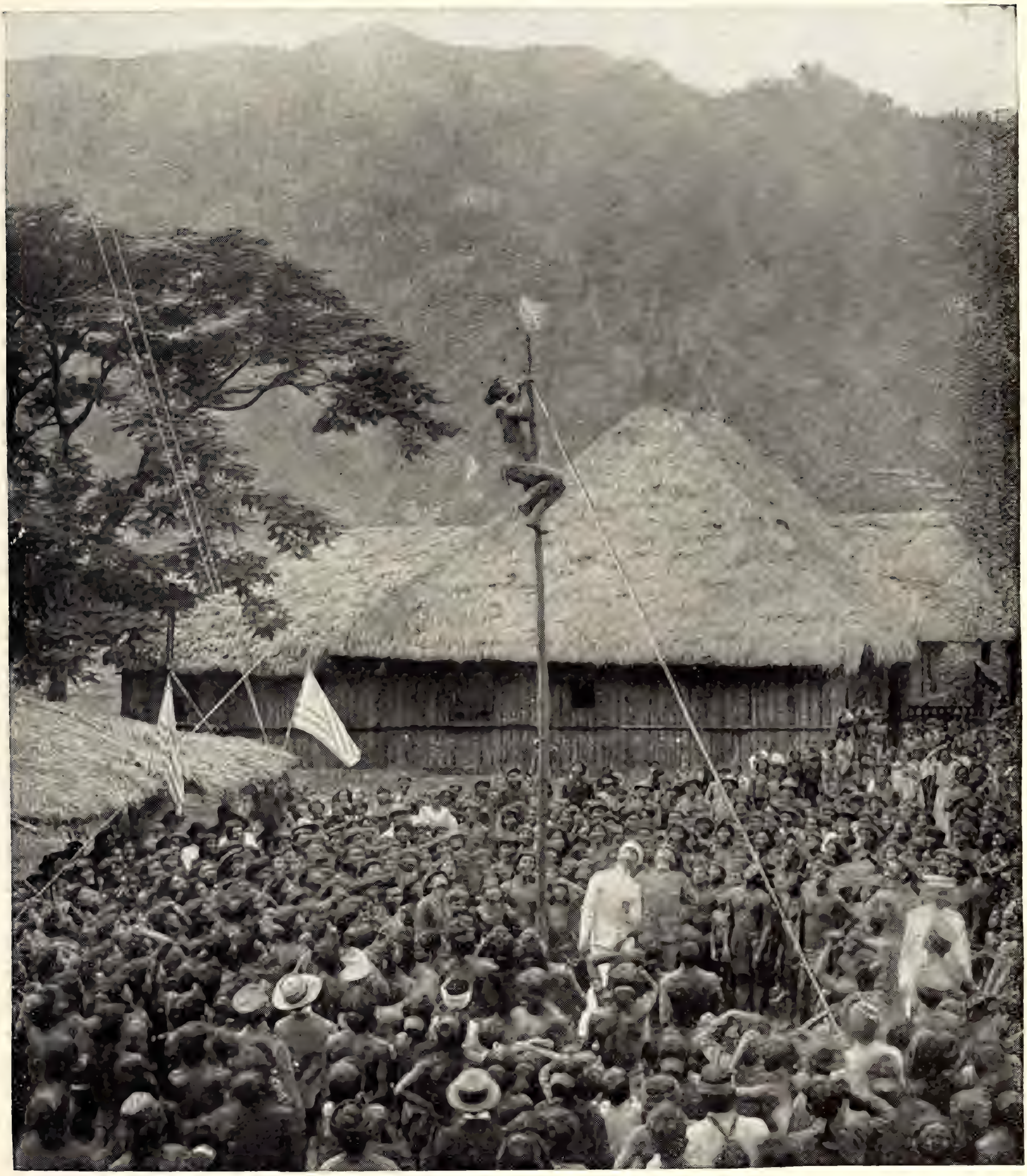
Samoqui and Talubin, old enemies, are to pull first, twelve men on a side, coached by their respective *presidentes* and cheered on by most of the male citizens of their respective towns.

A heavy rope is produced and a white string is tied at its center for a marker. Two canes are stuck up a yard apart, and the American referee puts his foot on the rope with the white mark exactly midway between these canes. The members of the two teams silently take their places and vigorously begin to dig footholds. The "anchors" have no belts, but wrap the ends of the rope around their bare waists. Each *presidente* counts the members of the opposing team to be sure that their number is correct. The men are now warned to get ready. Digging ceases and they stand like statues.

The pistol cracks and the rope tightens



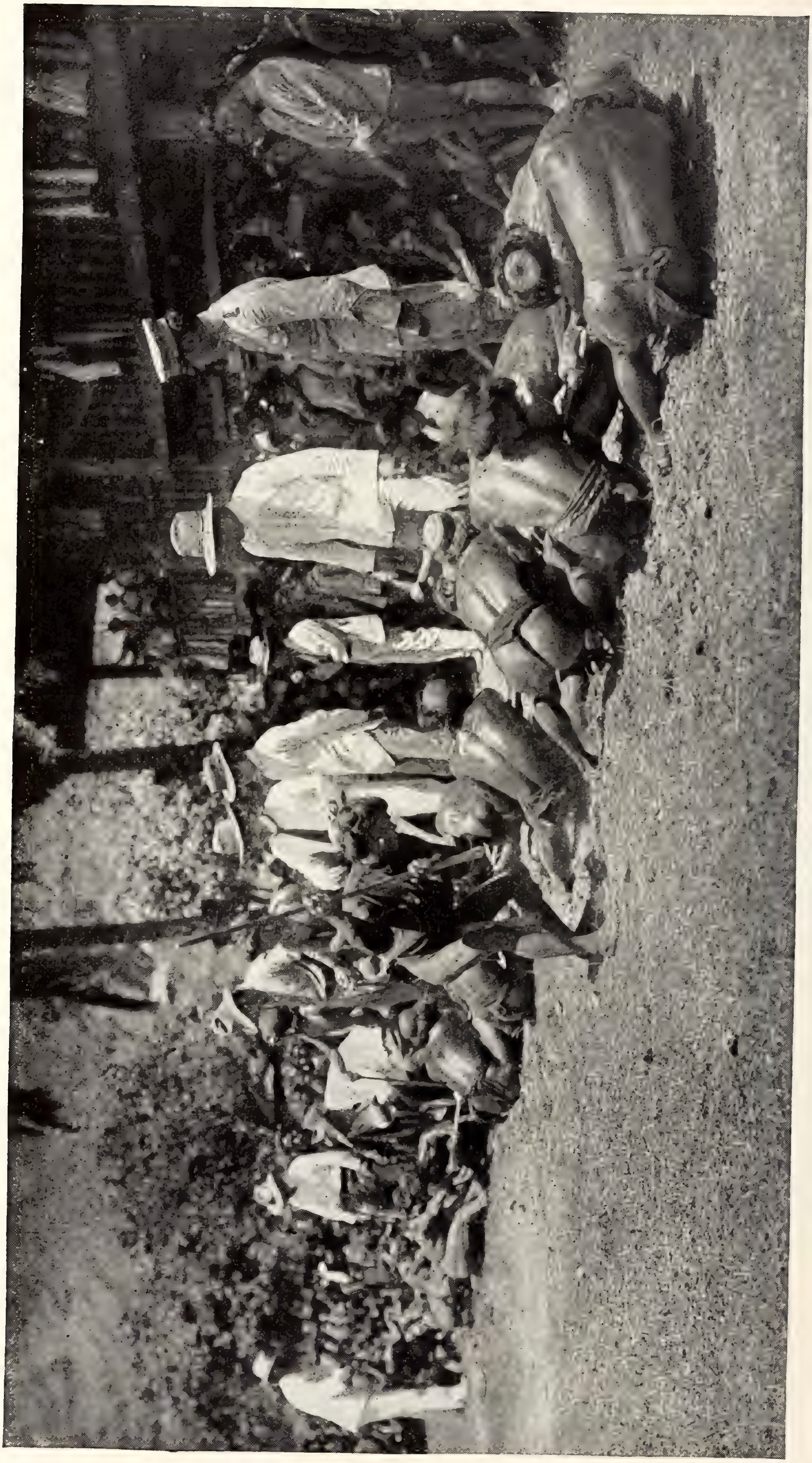
A POPULAR AMERICAN SUBSTITUTE FOR HEAD-HUNTING: THE GREASED-POLE CONTEST



CLIMBING THE GREASED POLE

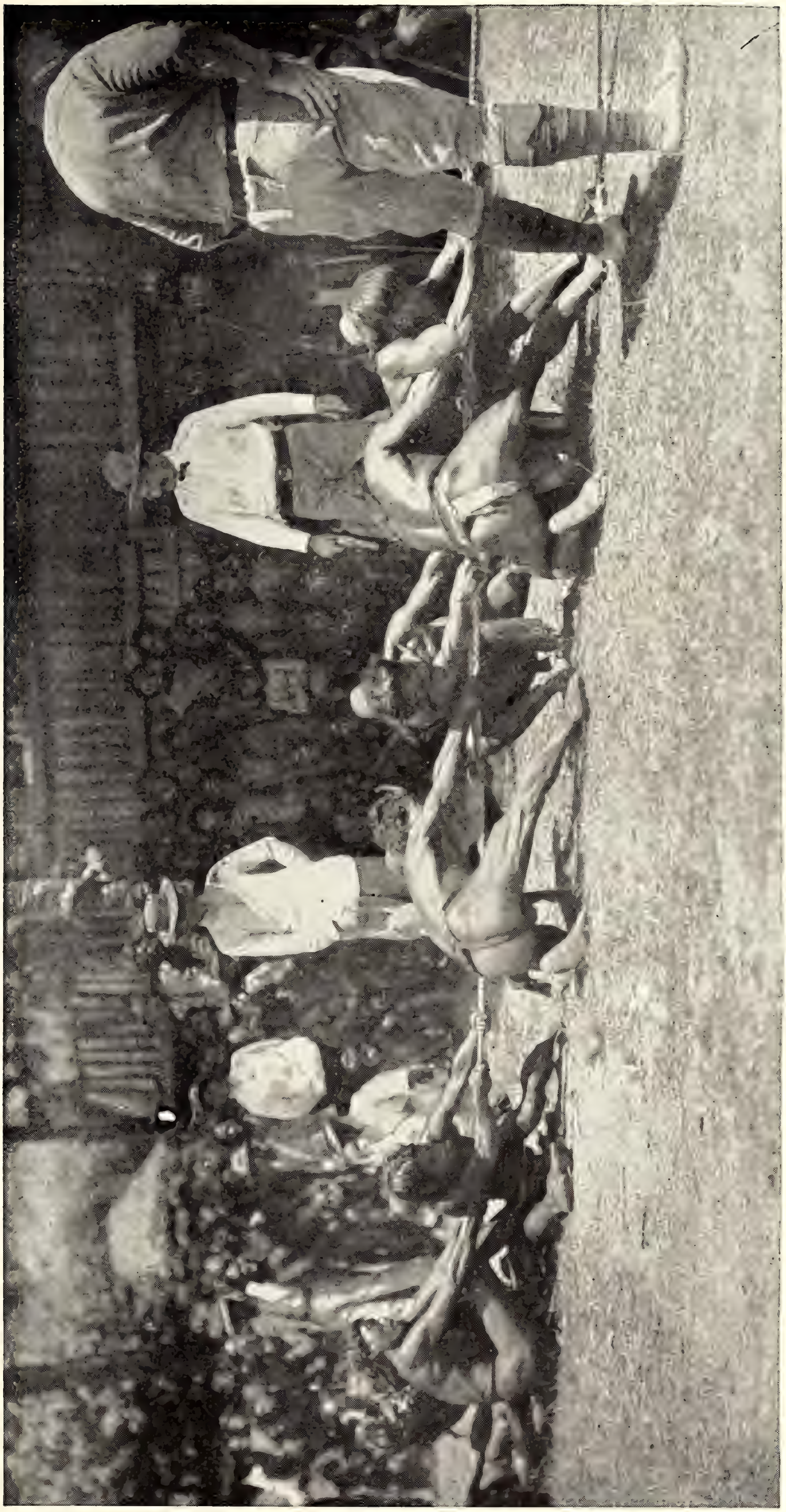
"A long-haired heathen from the north starts with a running jump, goes up the bamboo like a streak and grabs the money bag" (see page 239)

with a vicious strain. The white marker has apparently not deviated from its central position by a hair's breadth. Both teams have dropped exactly together and now how they pull and how their perfectly developed muscles stand out! A minute goes by, then two, three, four. The rope moves a bit. Talubin gains an inch and loses it; gains two inches and holds one of them for a while. Then the white marker slowly but very steadily moves back whence it came and continues to move toward the Samoqui side. Samoqui is too heavy for Talubin.



ANOTHER SUBSTITUTE FOR HEAD-HUNTING: A TUG-OF-WAR BETWEEN BONTOC IGOROTS OF SAMOQUI AND TALUBIN

The pulling has just begun (see page 239)



TUG-OF-WAR BETWEEN SAMOQUI AND TALUBIN

This photograph shows a part of the Talubin team pulling their hardest

AN ENTHUSIASTIC AMERICAN COACHING TALUBIN, WHO ARE WEAKENING: THE ROPE IS SLIPPING THROUGH THEIR HANDS

An enthusiastic American, who perhaps himself pulled in his college days, rushes up to coach the Talubin men. He tries to get them to heave, and to heave together, but it is now too late. They can only hold on for dear life while the rope is gradually pulled through their burned and bloody hands. Samoqui heaves and gains three inches. She heaves again and gains half a foot. She heaves a third time and the white marker passes the cane on her side.

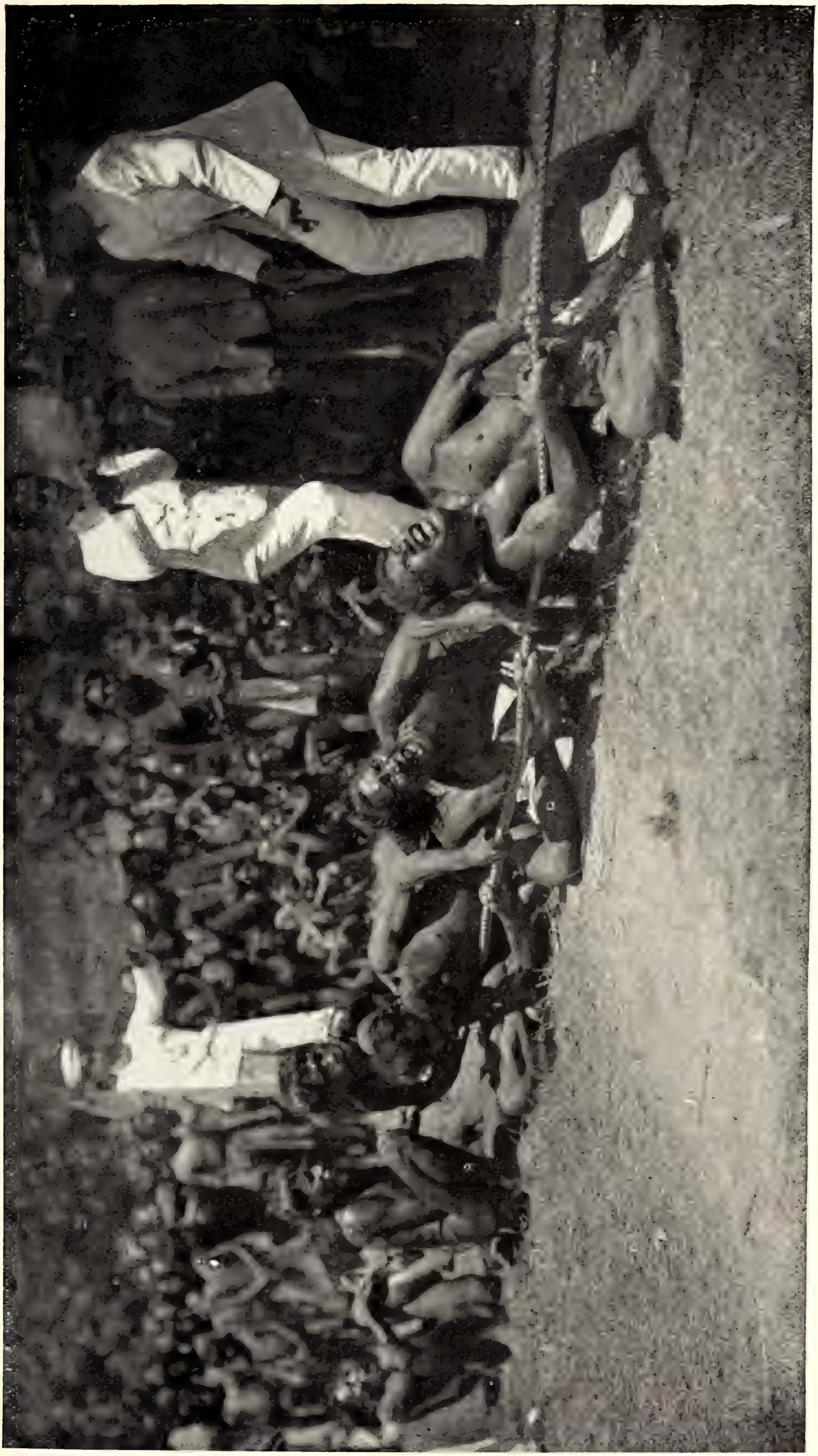
So Samoqui wins, after 7½ minutes of pulling that would disable the members of a white team. The yelling has been ear-splitting before, but now pandemonium breaks loose. The backers of the Samoqui team leap into the air and scream themselves hoarse. Talubin yells a little herself just to show that there is no hard feeling, and every one else joins in for luck. Ultimately the tumult lulls, and, while the Talubin people are telling the Samoqui men what they will do to them next year, Tucucan and Tinglayan line up for the next pull. So the fun continues until darkness falls and the crowd adjourns for its evening meal.

A DELEGATION FROM LUBO

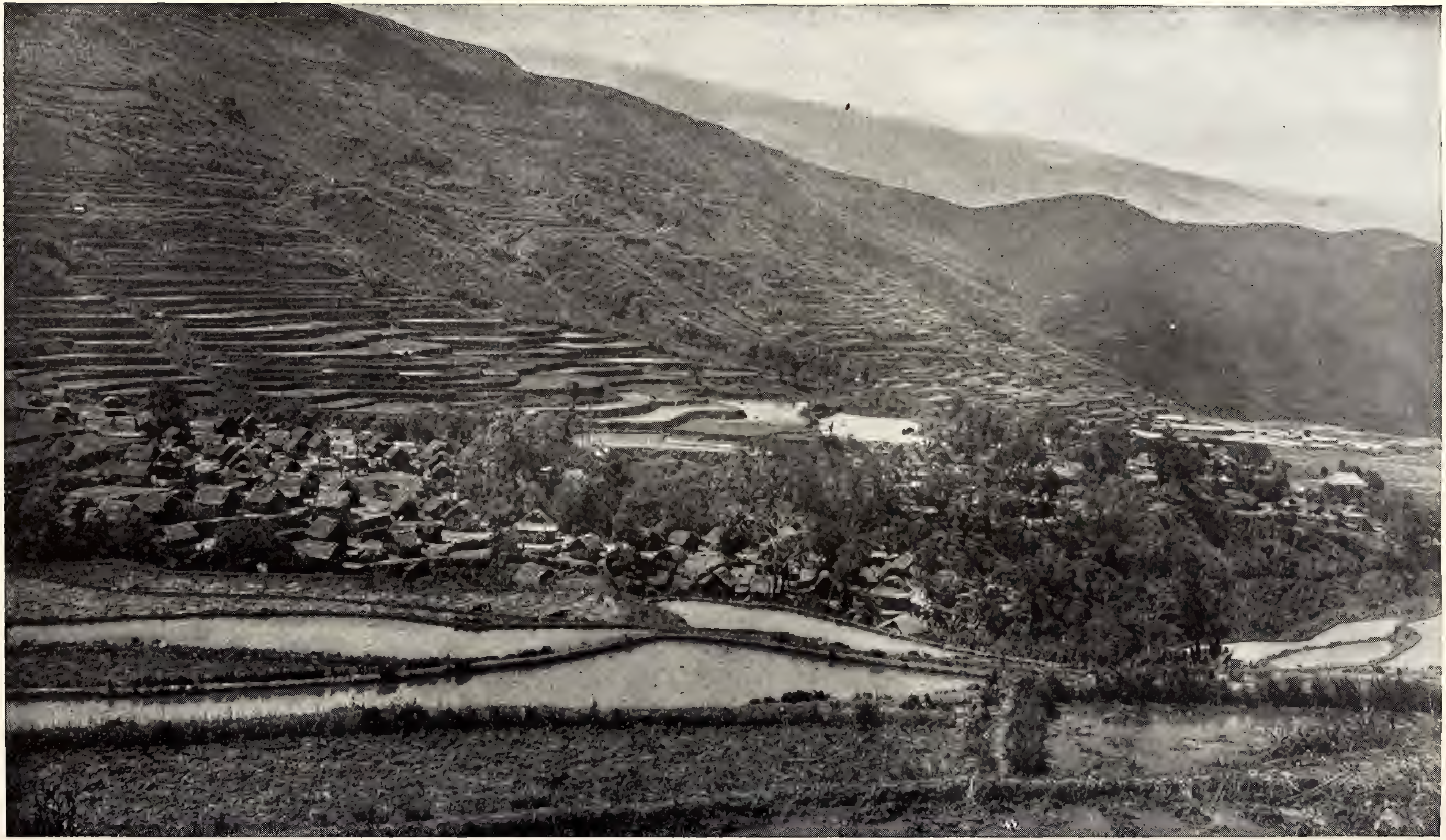
Now great fires blaze out on the plaza, and around them the fighting men gather and sing the fame of warriors who are dead; sing of their own brave deeds; of their troubles with the Spaniards; of the coming of the Americans with their strange new ideas, and of all that has since happened down to the day which is just ending. Until customs change, no secret service will ever be needed in Bontoc. If a head has been taken, go and sit at the camp-fires and sooner or later the guilty man will sing and tell you all about it.

Now and then a particularly enthusiastic delegation dances a bit. We are tired out, so turn in, and the singing and the dance music soon mingle with our dreams.

It is 5 a. m. and we are in the saddle



THE FINISH: SAMOQUI WINS: THIS IS THE WINNING TEAM

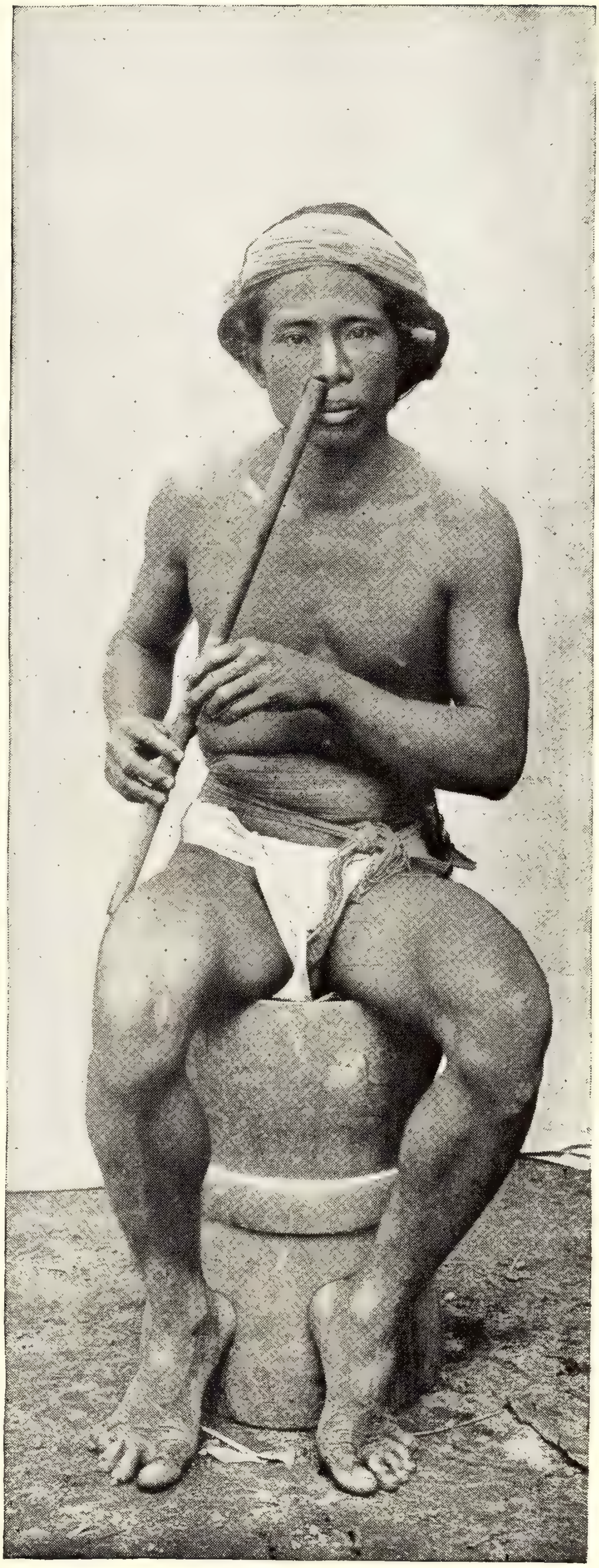


PART OF THE IGOROT TOWN OF LUBUAGAN, SHOWING THEIR RICE TERRACES (SEE PAGE 247)

Though so savage that they were head-hunters until Americans put an end to the practice, they had developed on their mountain sides terraces that for ingenuity and laborious construction equal any in the world and off for Lubuagan, distant 54 miles, in traveling which we shall climb and descend many thousand feet. Between 10 and 2 o'clock it will be too hot for our ponies, so we must take two days for the trip.

Late in the afternoon of the second day, while resting at Bañgad, we are met on the trail by a delegation of 29 men and one woman from Lubo. Lubo is the town that attacked former Lieutenant Governor Folkmar and got burned out for its pains. It has recently sent Lieutenant Governor Hale word that it would take his head; but Lubo says that it has finally decided to be good and is voluntarily coming to Lieutenant Governor Hale's capital, where it is likely to meet the Mangali people, with whom it has been fighting within a few weeks. There is a suspicious circumstance about the makeup of this party. It includes but one woman. War parties take *one* woman with them; friendly parties take *two!*

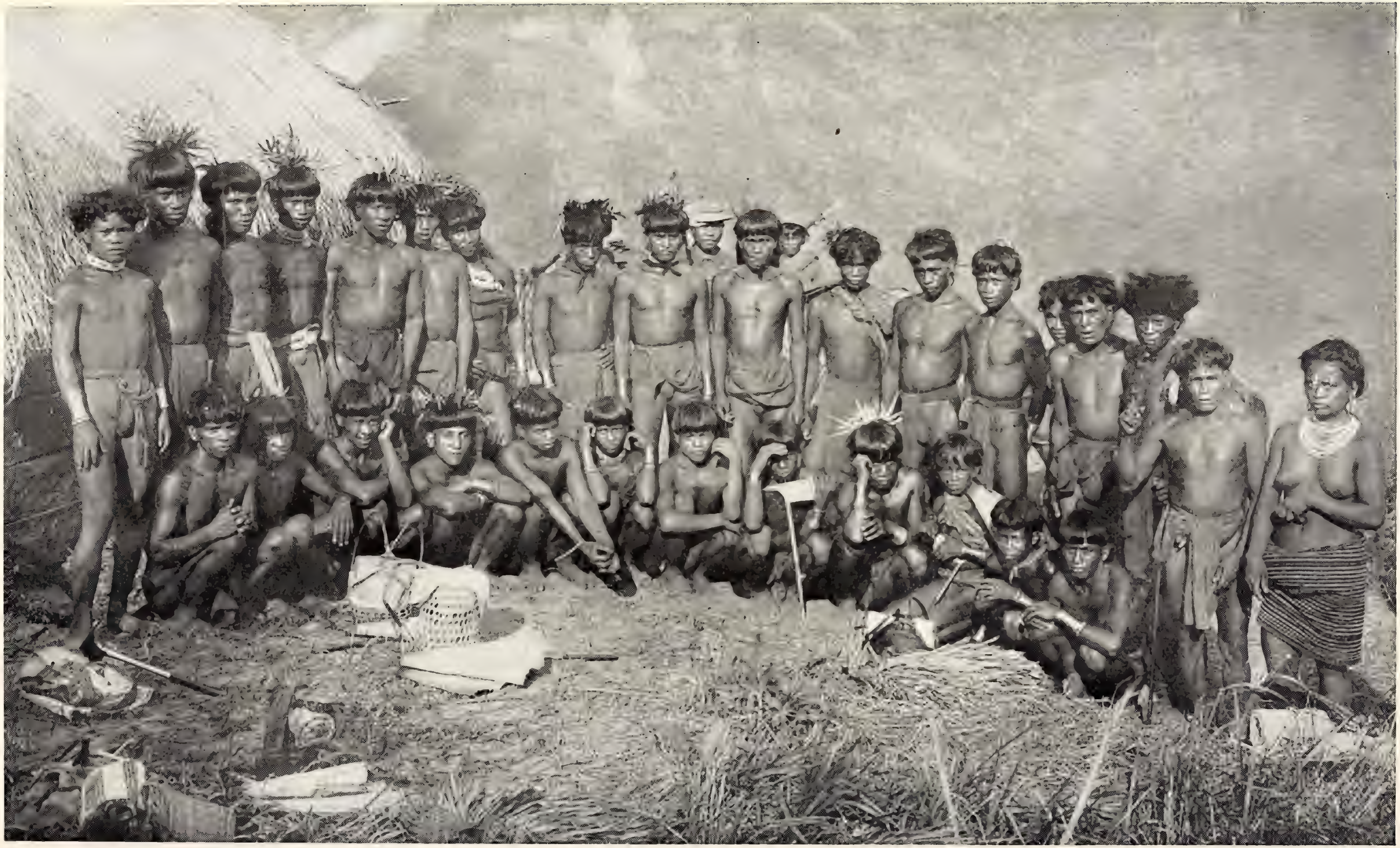
As we continue our journey the Lubo men fall in behind us, and we keep a sharp eye on them. We reach Lubuagan after dark and are escorted into town by Igorots who have come out in the rain with torches to meet us. There are but few people about the plaza when we awake in the morning, but more come in rapidly, and by the time breakfast is over dancing has begun. The Lubuagan Igorots are probably of the same tribe as their neighbors of Bontoc on the south, but differ from them materially in dress and in ornaments. The leading men of the Lubuagan Igorots wear elaborate and beautiful feather head-dresses and rattan caps ornamented with agate beads. Frequently, also, they stick scarlet hibiscus flowers into their hair. The women wear handsomely woven and brightly colored skirts, supported underneath at the waist by numerous coils of braided fiber cord. Some of them also wear upper garments, which they usually discard when they dance.



A TINGIAN PLAYING THE NOSE FLUTE

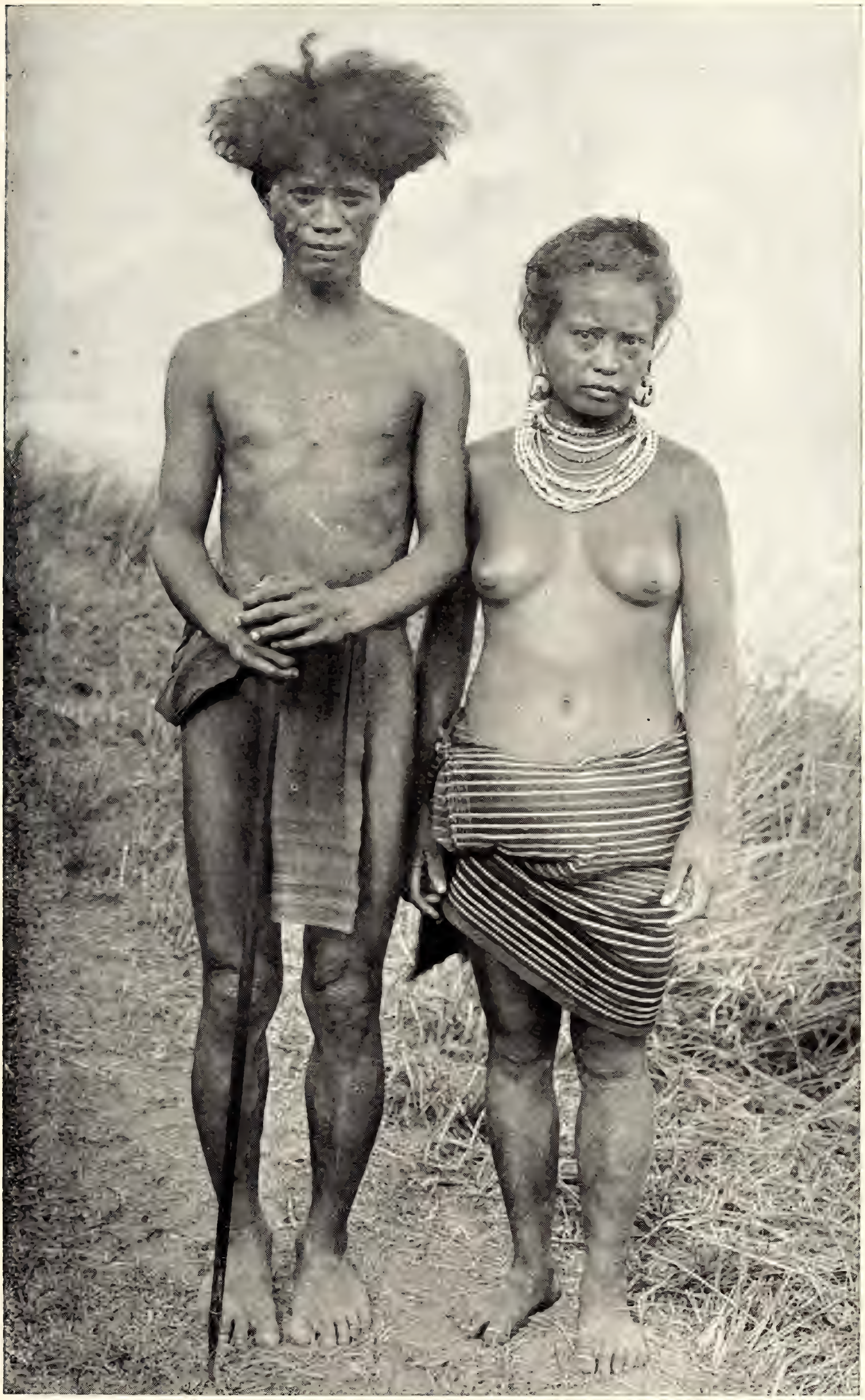
Of the many remarkable musical instruments in use in the Philippines, the nose flute is one of the oddest.

The dancing is better than any we have heretofore seen. Eighteen *gansa* players enter the circle at once, and 30 or 40 women and girls join them, danc-

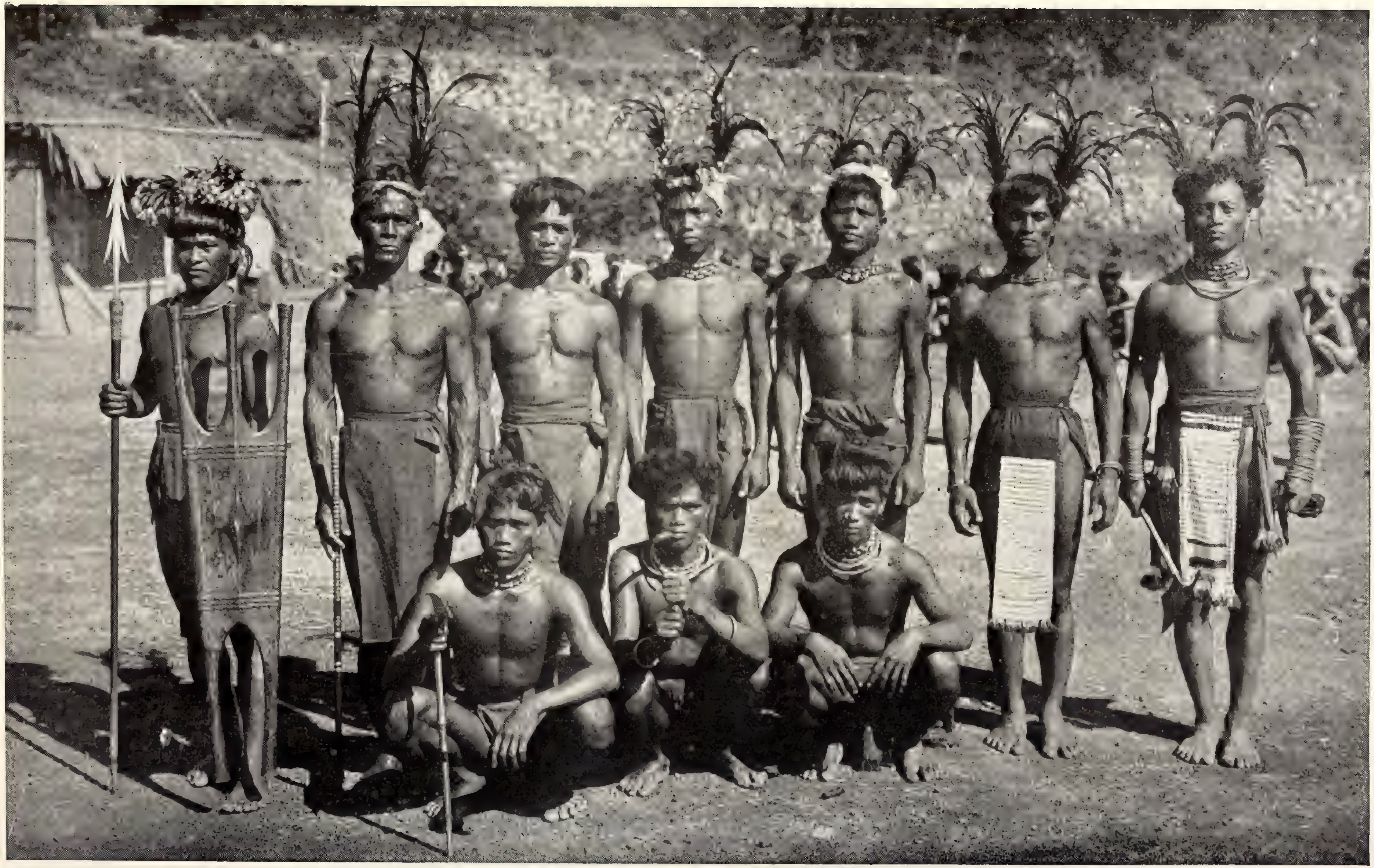


THE DELEGATES FROM LUBO WHO ARE COMING TO A CONFERENCE WITH SECRETARY WORCESTER FOR THE FIRST TIME

They brought only one woman with them, which was a suspicious circumstance, as war parties take one woman, while friendly and trading parties take two (see page 247)

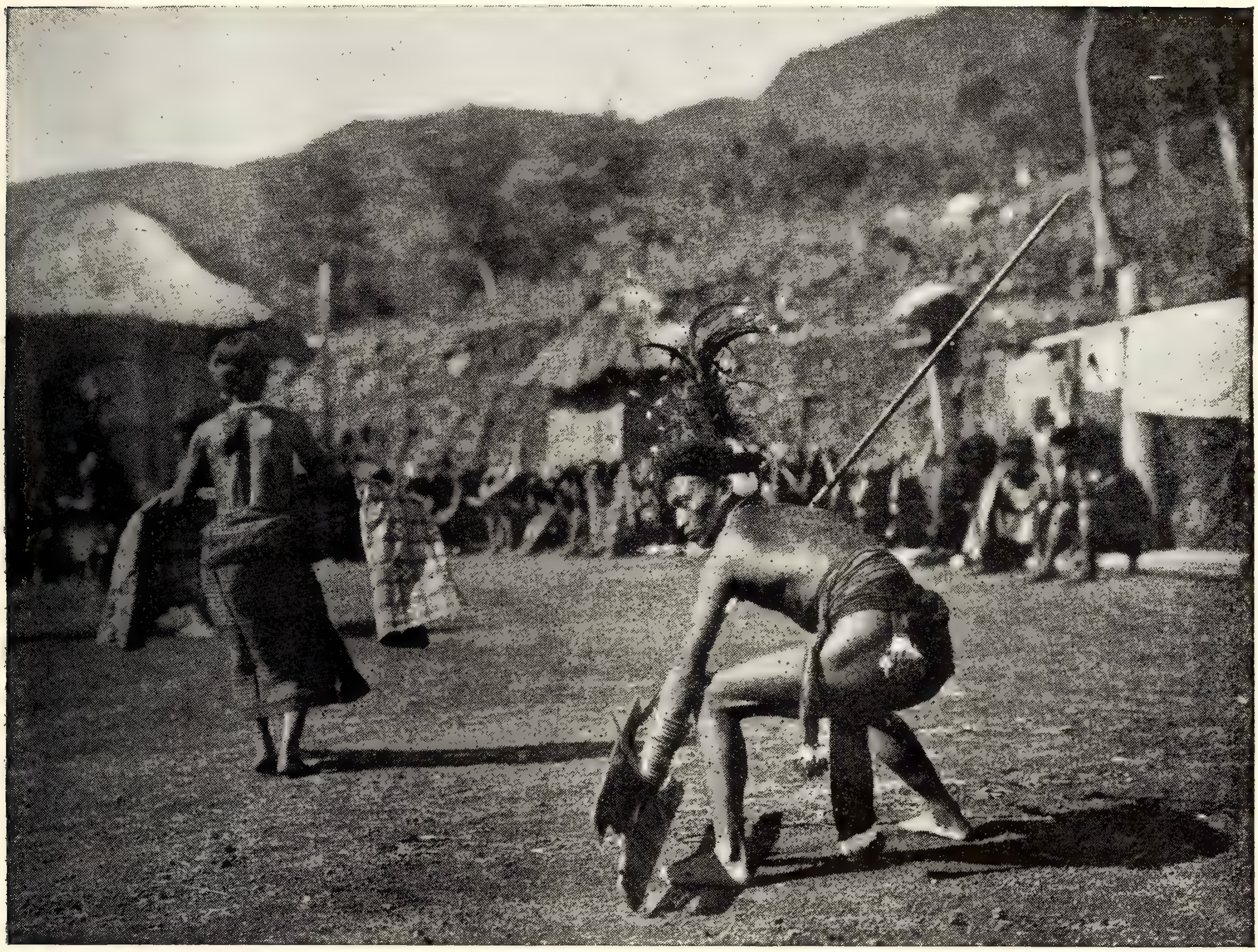


THE HEADMAN OF LUBO AND HIS WIFE (SEE PAGE 248)



BONTOC IGOROTS OF LUBUAGAN

These are picked men, who dance for their town on festal occasions. Note the muscular development of their chests. The man on the extreme right holds a head axe in his right hand



THE DANCING MASTER AT LUBUAGAN

ing with the light, springing steps and upturned hands of the Bañgad girl whom we saw at Bontoc.

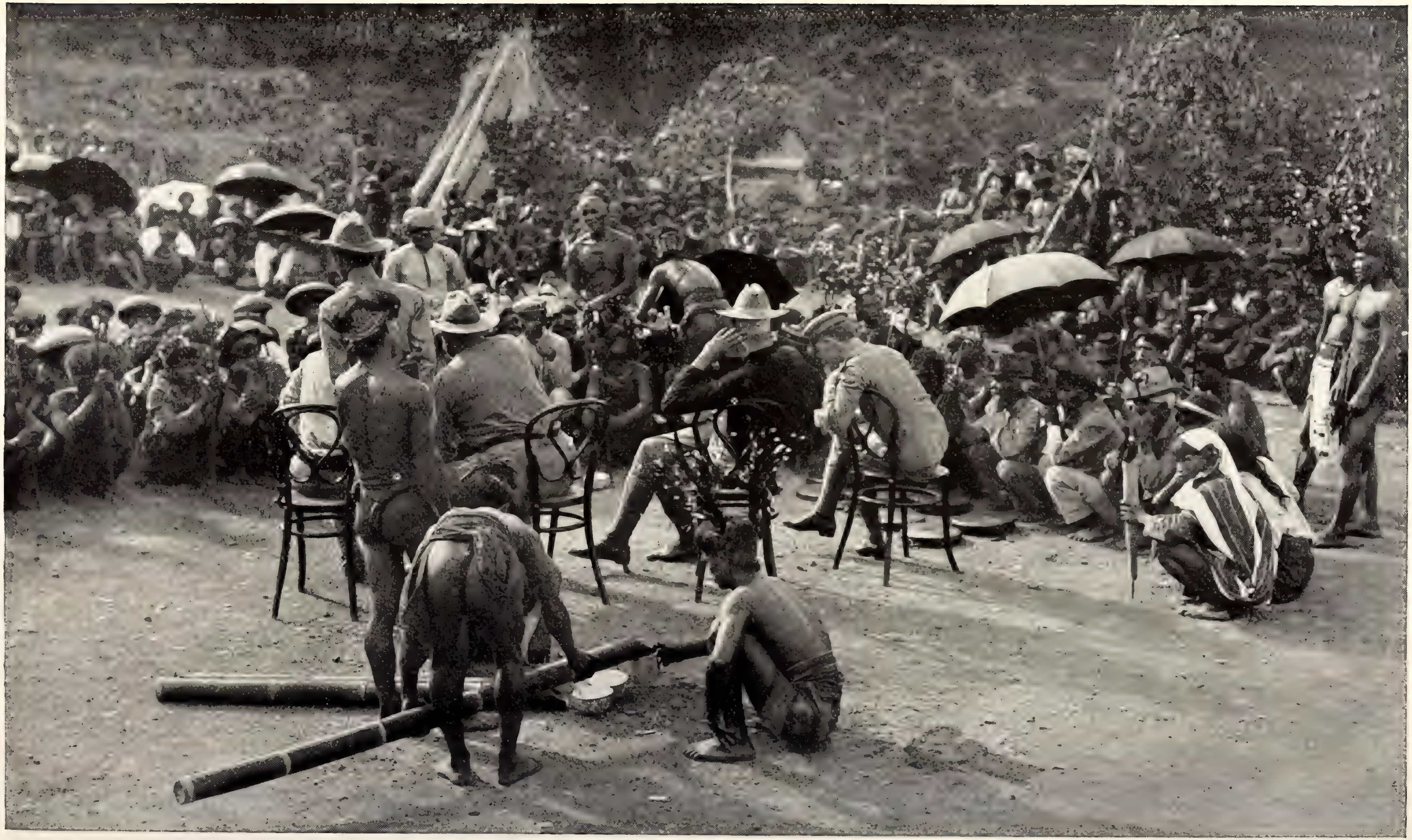
LUBO AND MANGALI MAKE FRIENDS

At this stage of events the Mangali delegation suddenly and unexpectedly appears on the plaza *armed*. Mangali is another town that said it would not come in, and its representatives have now shown bad taste in coming fully armed into a crowd of unarmed men. After they have been received in a friendly manner, their attention is called to this fact, and they retire in a shamedfaced way, leave their arms in a safe place, under guard, and return to dance before their enemies of Lubo, who in turn dance before them. When they first appear, Lubo wants to leave, but is refused permission. After Lubo has danced, Mangali wants to leave, but permission is again denied.

The fact is that the men of Mangali and Lubo have never before seen each other except over the tops of their shields when lances were whizzing through the air. At first they glare at each other menacingly, but as the day wanes the general spirit of good cheer has its effect and they become less hostile. Finally the two chiefs, each with a few followers, approach each other, squat on the ground, and begin to talk. Lieutenant Governor Hale uses this favorable opportunity to intervene, and before the discussion ends Mangali and Lubo have formally agreed to make peace on the morrow. Thus a bloody feud, which has lasted for no one knows how long and has cost many lives, is ended.

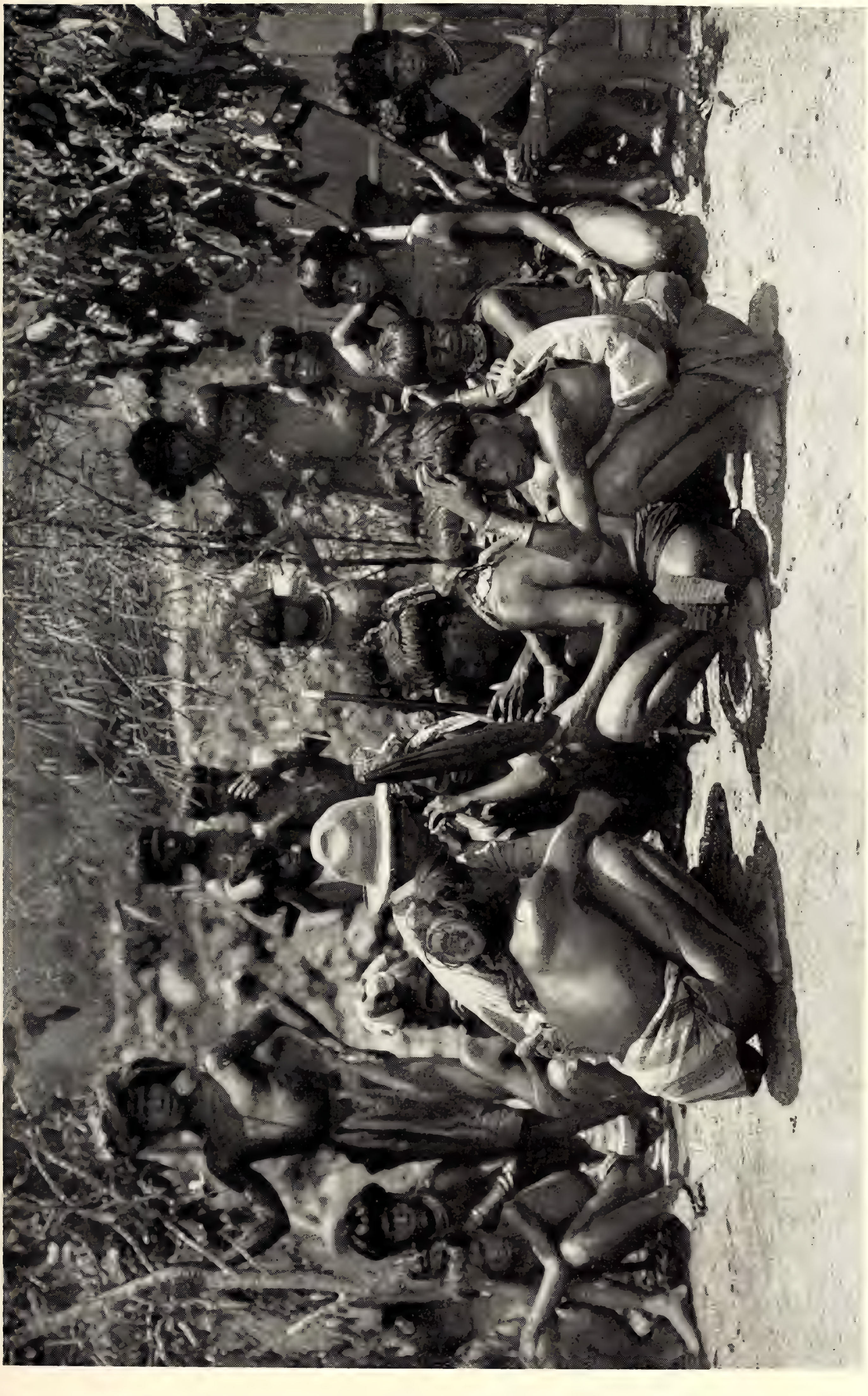
THE IFUGAOS

We now retrace our steps to Bontoc and thence proceed to Banawe, the capi-

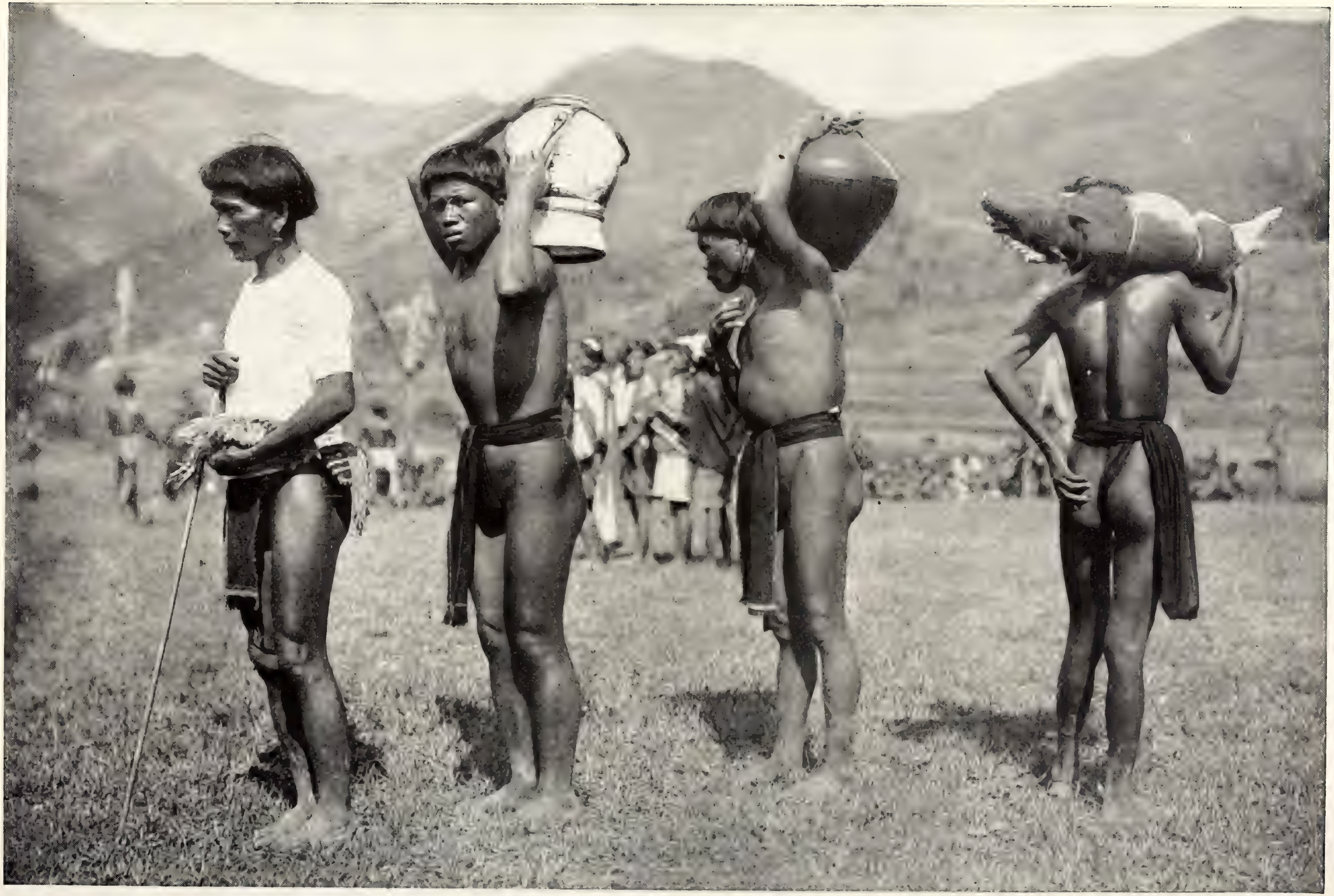


A CONFERENCE WITH KALINGA HEADMEN AT LUBUAGAN

Chief Atumpa is speaking. A Kalinga warrior is pouring *basi* from the bamboo in which it is kept, and the Kalingas will soon ask the American officials to show friendship by drinking with them



LIEUTENANT GOVERNOR HALE MAKING PEACE BETWEEN THE TOWNS OF MANGALI AND LUBO: NOTE SITTING POSTURE
(SEE PAGE 251)



IFUGAO CHIEF COMING IN BRINGING THE USUAL GIFTS TO MAKE FRIENDSHIP, A WHITE CHICKEN, SIX EGGS IN HIS OWN HAND, JUGS OF BASI, AND A PIG THROWN IN FOR LUCK

LISTENING TO THE TALKING MACHINE

tal of the subprovince of Ifugao, passing en route over the crest of the Polis range at an elevation of 6,200 feet on a trail which for many miles runs through a magnificent forest.

At the edge of this forest, on the eastern slope of the mountain, we are met by a delegation of Ifugaos, short-haired barbarians who until very recently have been inveterate head-hunters. Having shown their friendship by giving us a drink of *bubud,* they precede us, their headman carrying an American flag. He is followed by three *gansa* men, who play march music, to the tune of which we continue our journey. The country is thickly settled and each village sends out its flag-bearer and *gansa* men to escort us to the next. The trail runs along the steep mountain-side among the terraced rice fields of the Ifugaos, which are one of the wonders of the Philippines. When we sight the plaza at Banawe it is filled with a solid mass of humanity, which forms a great splotch of brown and black, relieved only by the white roosters' feathers and strips of white paper which the Ifugaos so dearly love to wear in their hair. There are no gay colors here. Clouts and blankets are of dark blue or black cloth, at the most with white stripes or small scarlet figures.

Again we are greeted by a tremendous shout, instantly followed by a sound of a very different nature. We could shut our eyes and imagine that we are at a football game, for a genuine college yell, given with a snap and vim that would do credit to Harvard or Yale, is ringing in our ears. "Wáh-wah, wáh-wah, wáh-wah, yí-i-i-i" shouts the crowd, and then it repeats the performance, trying to make a little more noise than it did before.

Dancing begins the moment we arrive and keeps up continuously throughout

MAKING THE ACQUAINTANCE OF THE CAMERA

the following night. It is strikingly different from anything we have seen before.

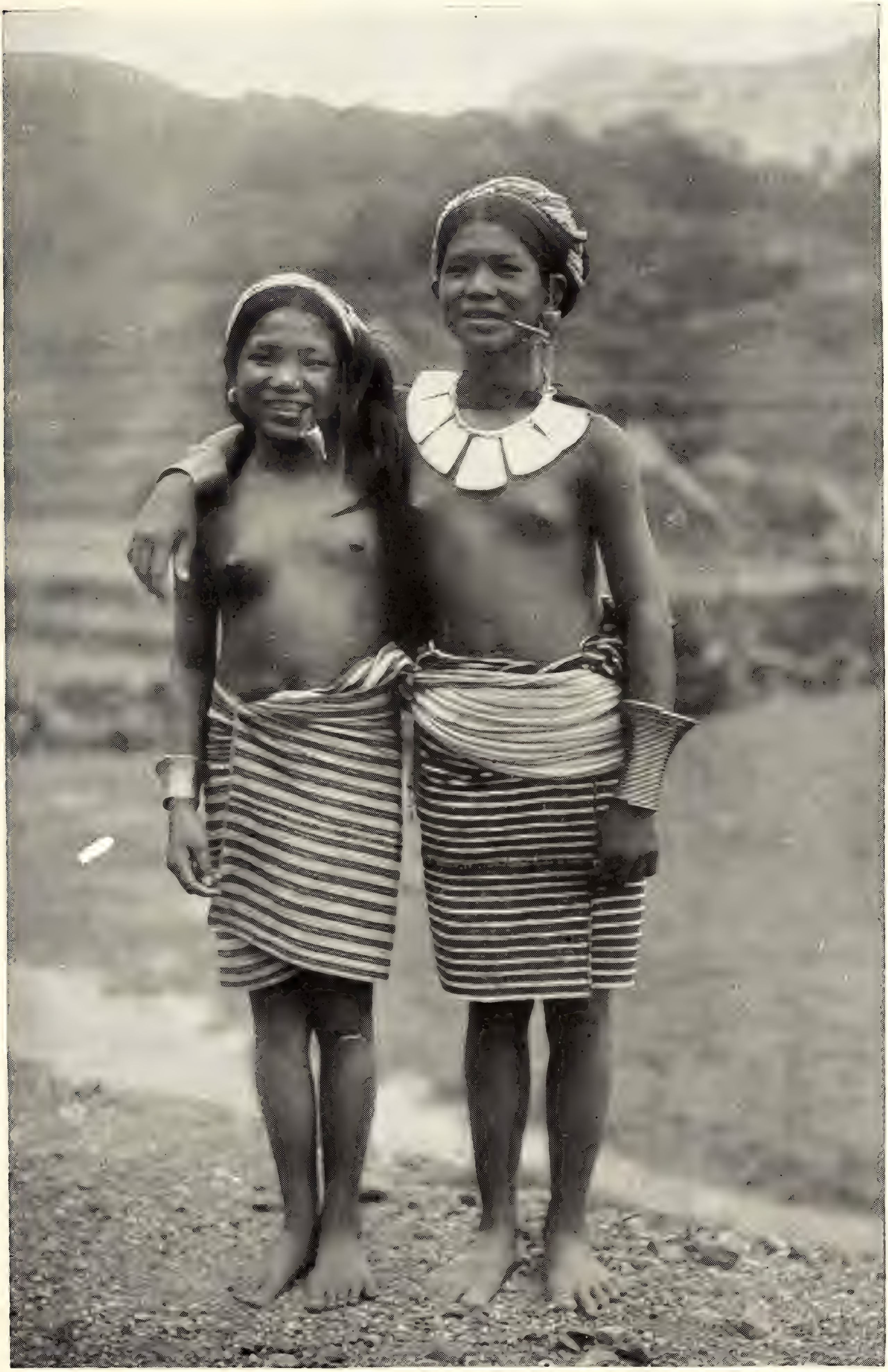
They dance in a circle, stamping smartly and showing great skill in their foot-work. First the left arm is stretched forward, while the right is extended backward; then this arrangement is reversed. Again one arm extends forward while the other is bent so that the hand comes just below the corresponding breast. As the dance progresses the arms are flexed and the hands and fingers moved in a manner that defies description, but some idea of it can be gained from the accompanying illustrations.

The crowd is soon increased to at least 3,000 by new delegations, each of which marches in to the tune of *gansa* music, sticks the handles of its lances into the ground, and comes forward to "present" to the authorities. The headmen bring their bottles or jars of *bubud* and their presents of chickens and eggs. The Ifugao is a great fellow to save documents, and preserves all scraps of paper on which his name is written. He insists upon your reading each of them, so that you may know who he is and what he has done.

In addition to dancing, we have lance-throwing and wrestling, but no foot-races or other American sports, as the Ifugao is conservative and prefers to celebrate his holiday in his own way.

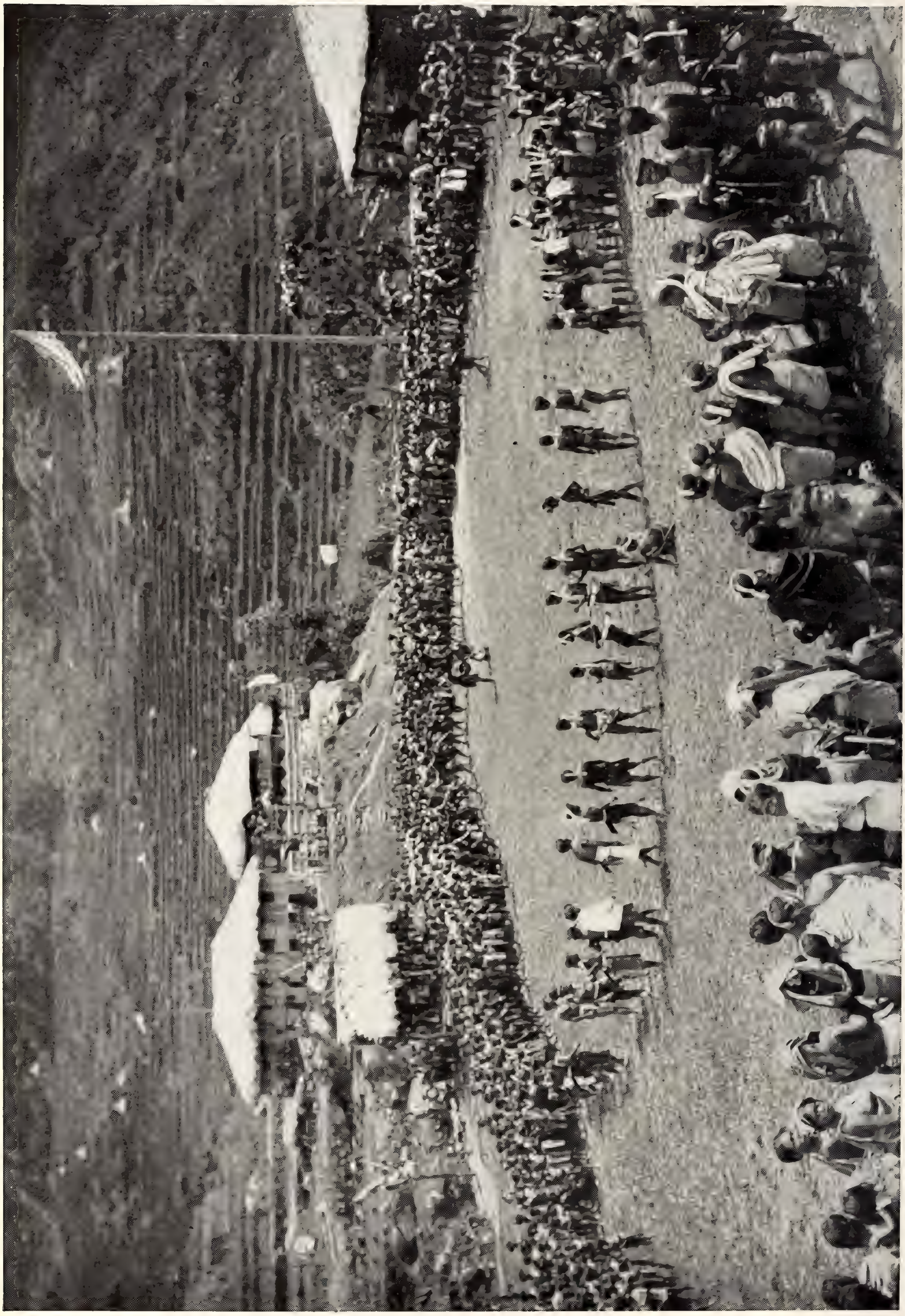
KILLING THE CARABAOS

Our next stop is at Kiangan. Here the program is similar to that at Banawe until we come to the meat distribution, and then we witness an extraordinary and bloody spectacle. The Ifugao is crazy for meat and especially for carabao meat. He has pigs and chickens, which are reserved to be eaten on festal occasions, but he keeps no cattle or carabaos. When a very rich Ifugao is going to give an especially important feast, he sends down into the Christians' country and buys one or two old carabaos. These he presents to his assembled friends, who



TWO JOLLY IFUGAO DANCERS

The right is the daughter of Mataag, one of the most famous head-hunting chiefs of Northern Luzon



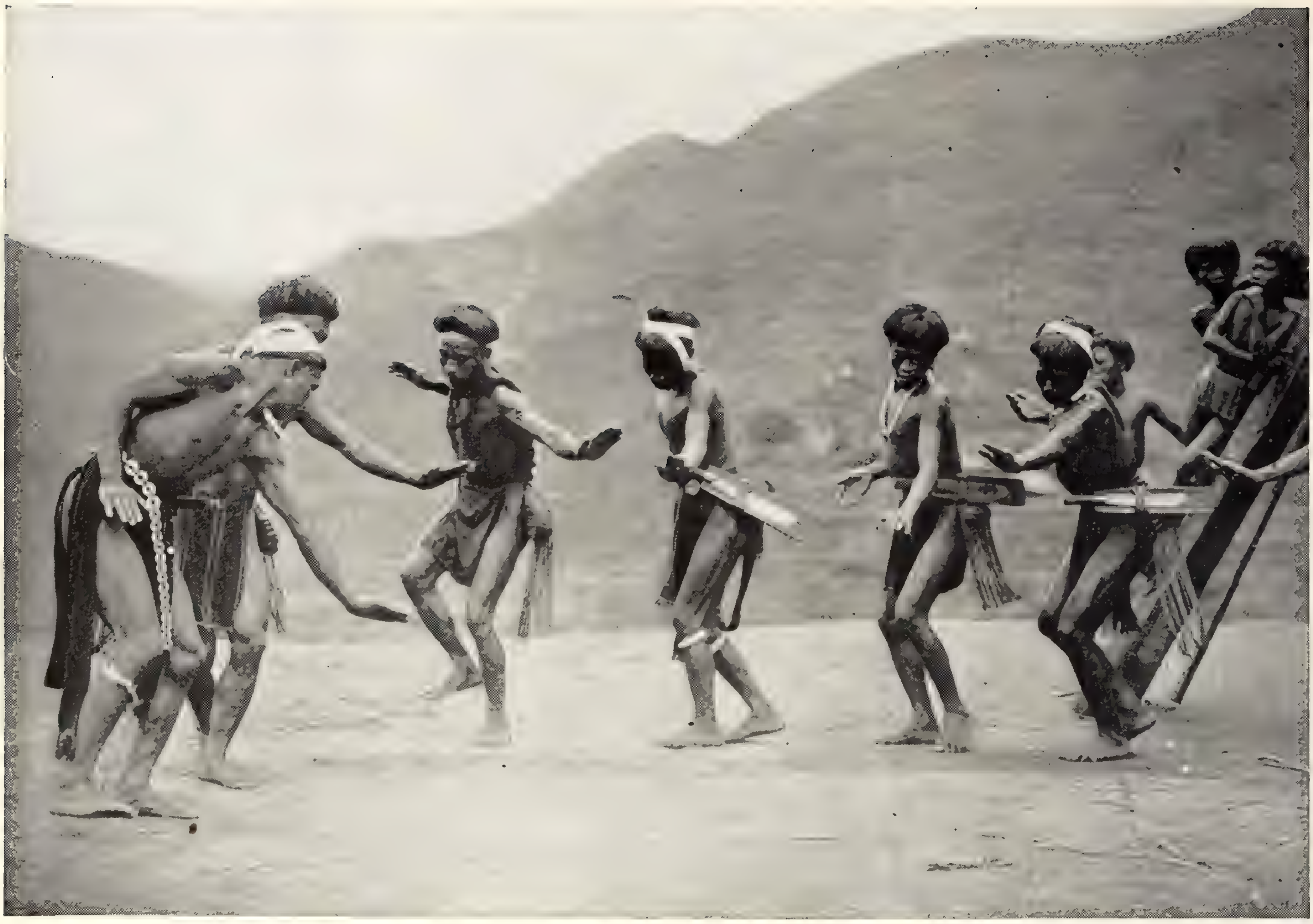
THE IFUGAOS DANCE IN A GREAT CIRCLE, STAMPING SMARTLY AND SHOWING GREAT DEXTERITY IN THEIR MOVEMENTS (SEE PAGES 260-261)

IFUGAOS DANCING ROUND A SACRED IMAGE

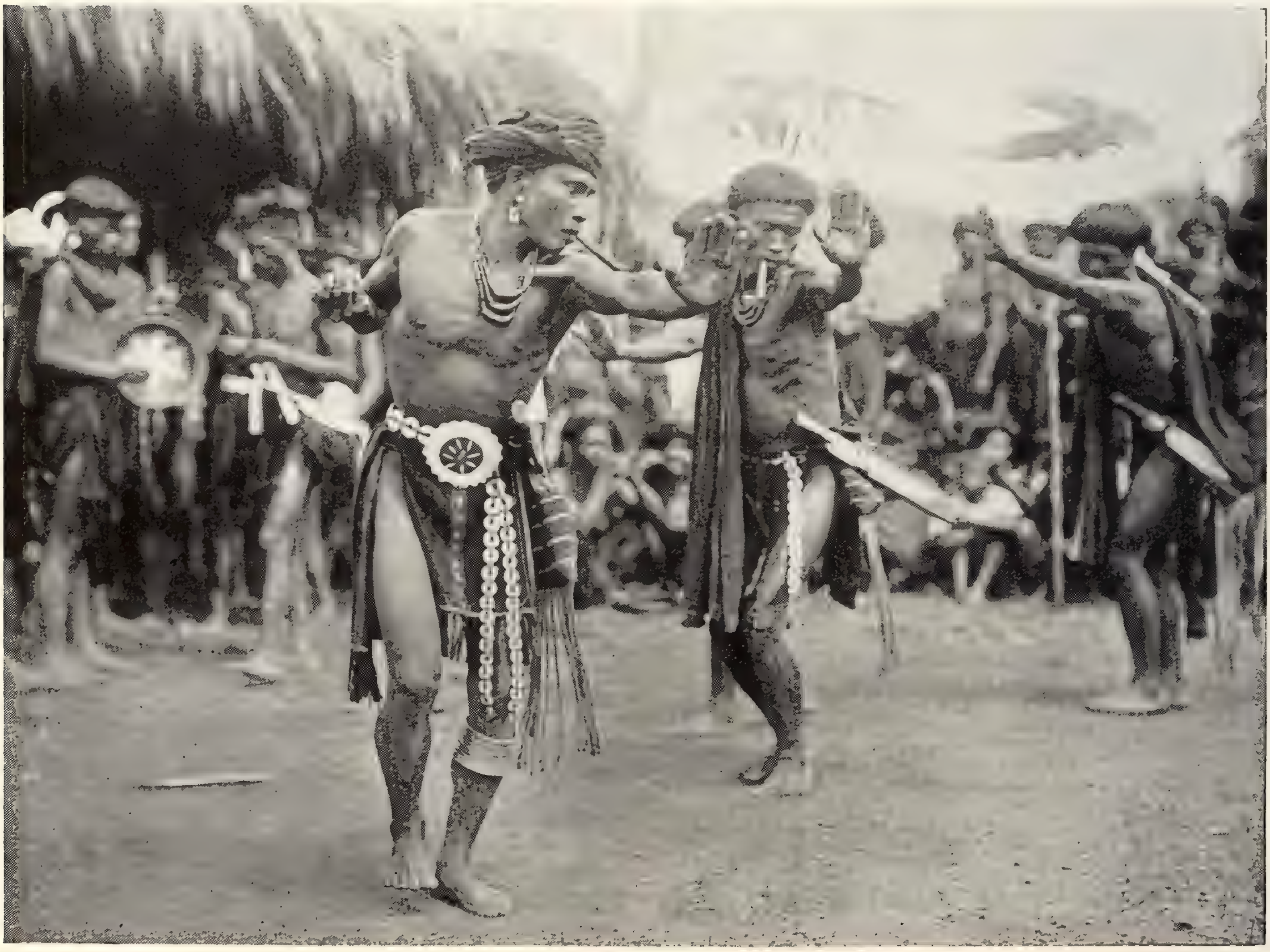
dispose of them in the savage manner we are now to witness.

A tough old carabao is led out on the plaza, surrounded by a score of experienced and wary warriors, each armed with a sharp, heavy bolo. They have need of daring and skill at the outset, for a wounded carabao is an exceedingly dangerous animal. Back of the bold few who are to cut the poor beast down there is a solid wall of men with drawn bolos, ready to rush in, chop the victim to pieces, and struggle for the meat. The man who is leading the carabao drops the rope and strikes him a heavy blow on the neck, trying to sever the spine. He fails and springs aside as his victim turns and lunges viciously at him. Two other men rush up from behind and try to hamstring the now infuriated beast. They, too, fail; but as he whirls to attack his new enemies a swarm of men beset him and rain blows on every part of his body. Down he goes, and the crowd rushes in on him with a roar.

Some men lie flat on the ground and cut and hack; on these others kneel, chopping away for dear life, while those who stand farther back bend forward and strike with their bolos. One fortunate individual manages to cut off the carabao's tail. Half a dozen others instantly lay hold of it, and, fighting vigorously for its possession, they push through the crowd, perhaps only to roll down a steep bank into a thicket of

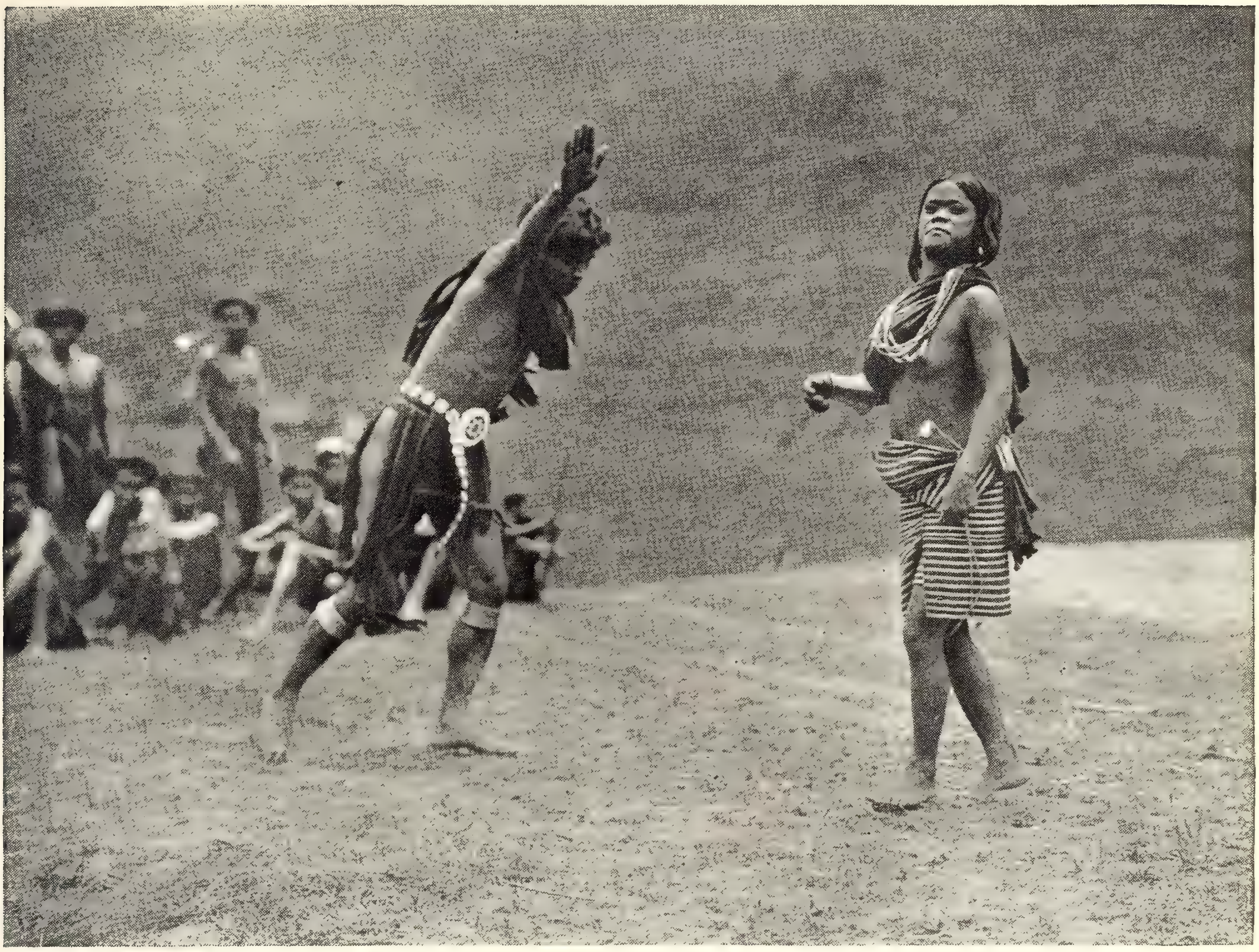


Note their knives or bolos



"The arms are flexed and the hands and fingers moved in a manner that defies description"

IFUGAOS DANCING AT BANAWE



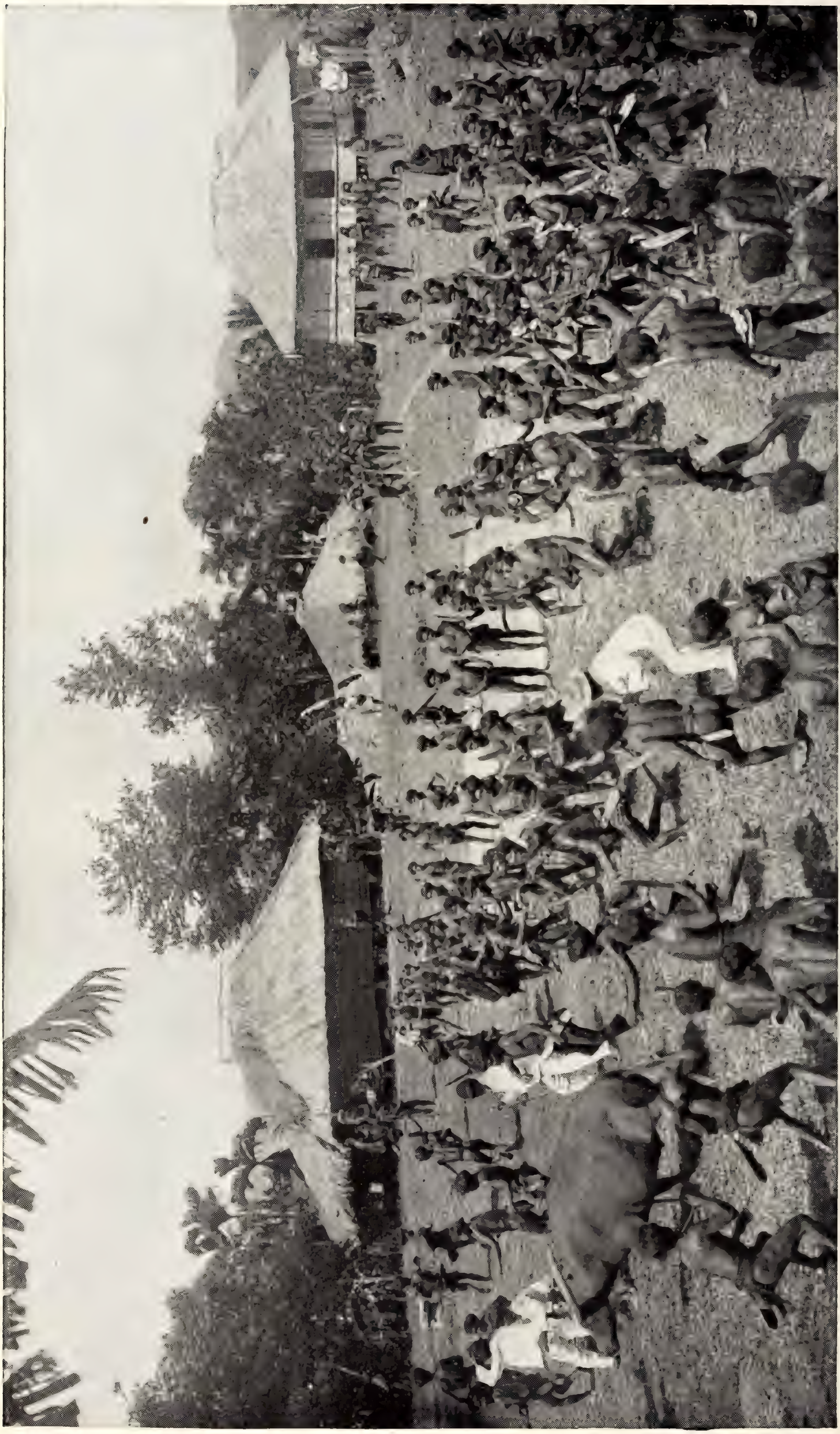
IFUGAOS DANCING: THE WOMAN HAS BEEN "SAUCED" BY THE CROWD AND IS TALKING BACK

thorny undergrowth, where they pull, tug, and threaten each other until all are tired out and one is able to get away with the tail, or until an agreement to divide it is reached. When a man has once placed a bit of meat on the ground he will not be further molested, but may turn it over to some less vigorous companion to keep for him, or stick it on the point of his lance, which he has previously thrust into the ground, point up. This done, he rushes back for more meat.

Before the carabao is through kicking his intestines have been torn out and the crowd has a tug-of-war with them, each individual retaining what he can get. When such a mob of people hacks recklessly with war-knives, it is inevitable that severe wounds should be accidentally inflicted. In every scrimmage a number of men are badly cut, but they accept their misfortune with absolute good nature, merely shrugging their shoulders and saying that it was their "*buni*," or luck. No ill-feeling is shown or felt on account of wounds received in a struggle for meat. If the Ifugaos were not extraordinarily skillful in the use of their war-knives serious injuries would be much more frequent. With half a dozen men tugging at a small piece of meat, I have seen an outsider neatly halve it with a single blow, and this without wounding any one!

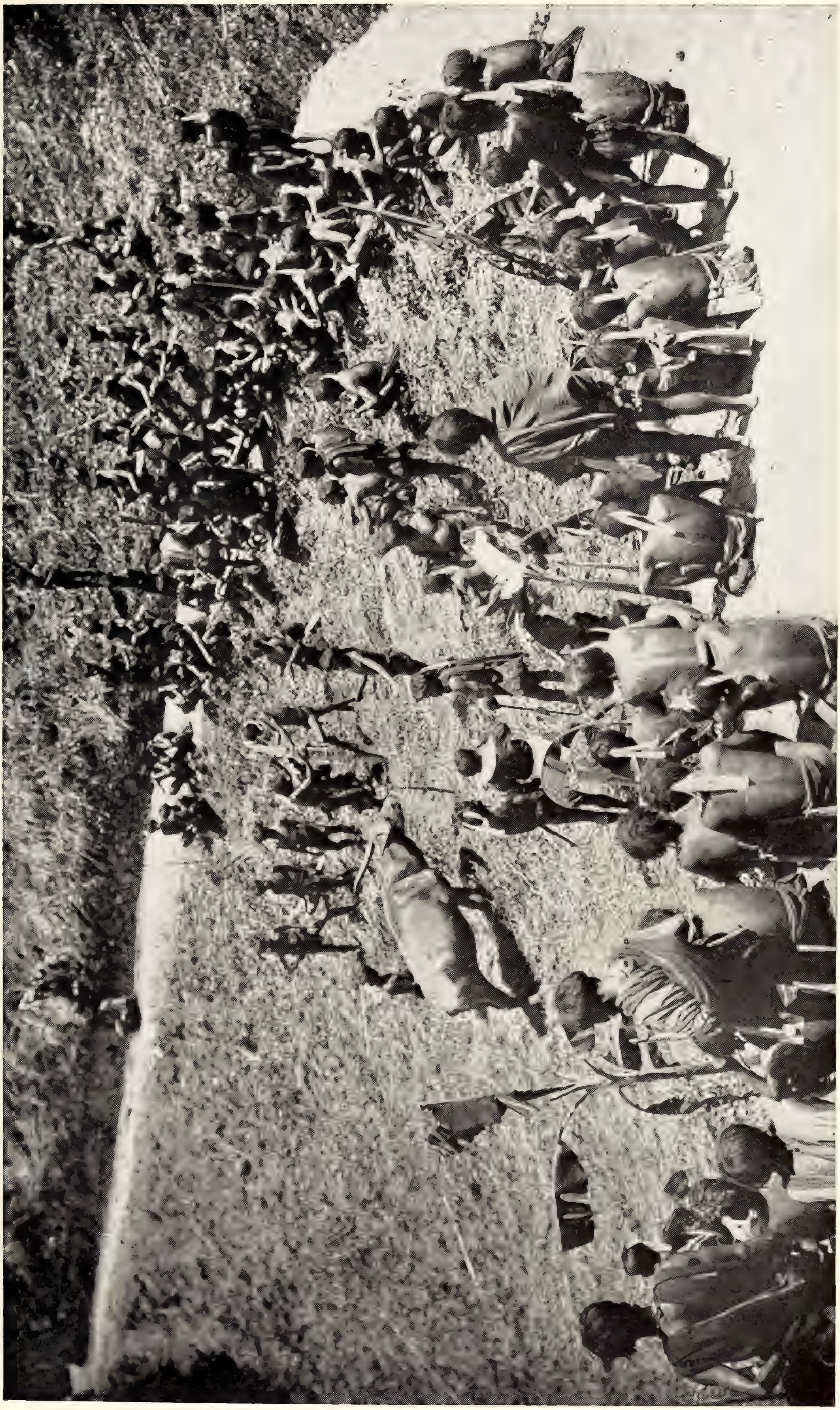
In ten minutes from the time the carabao is turned loose he has completely disappeared, having been chopped into bits and carried away. Nothing remains save a pile of partially digested fodder from his stomach, and small boys are hunting through this for stray bits of meat. The next victim is now led out.

We emphatically disapprove of turning

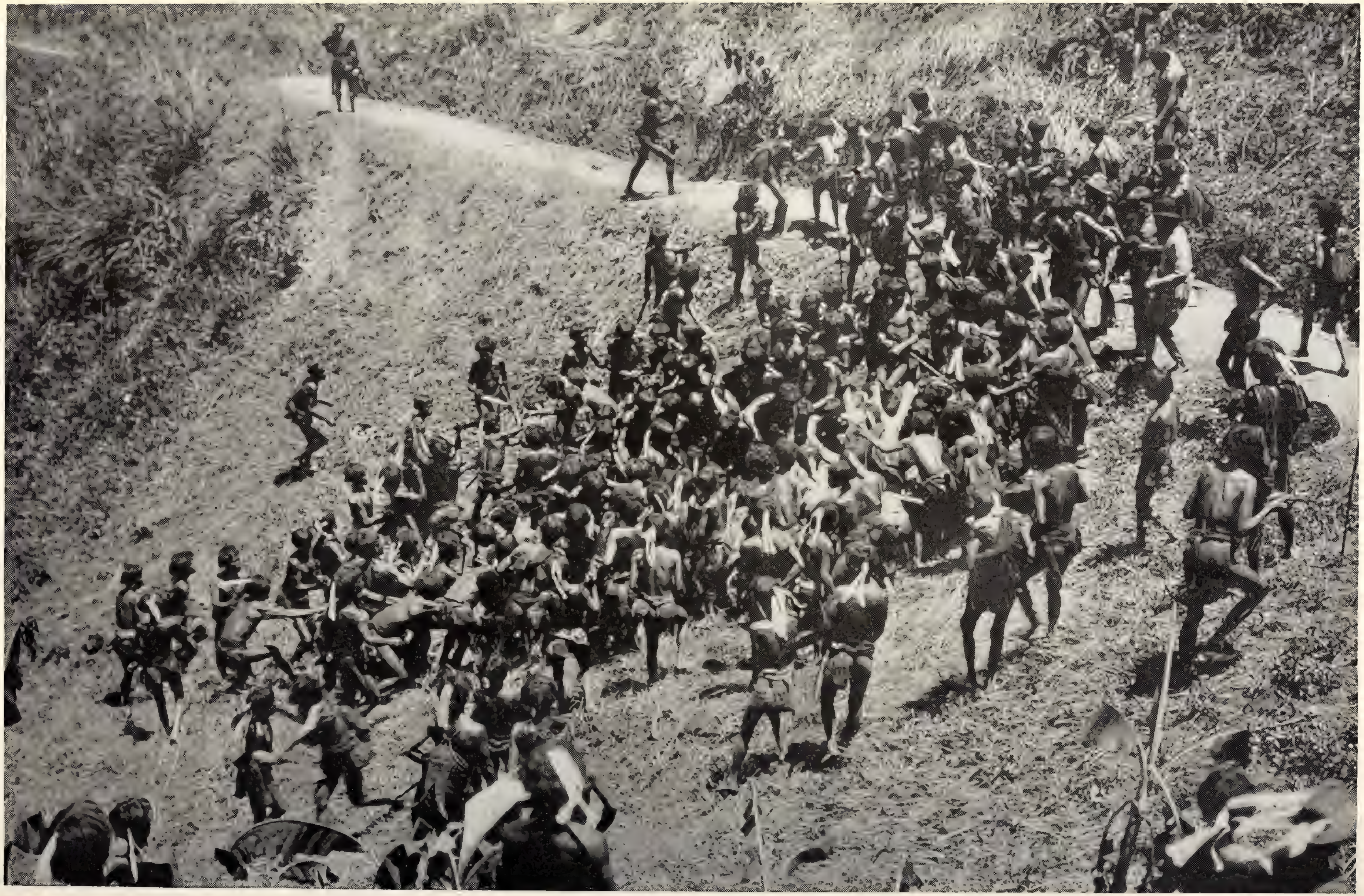


LEADING OUT A CARABAO TO BE TORN TO PIECES (SEE PAGE 259)

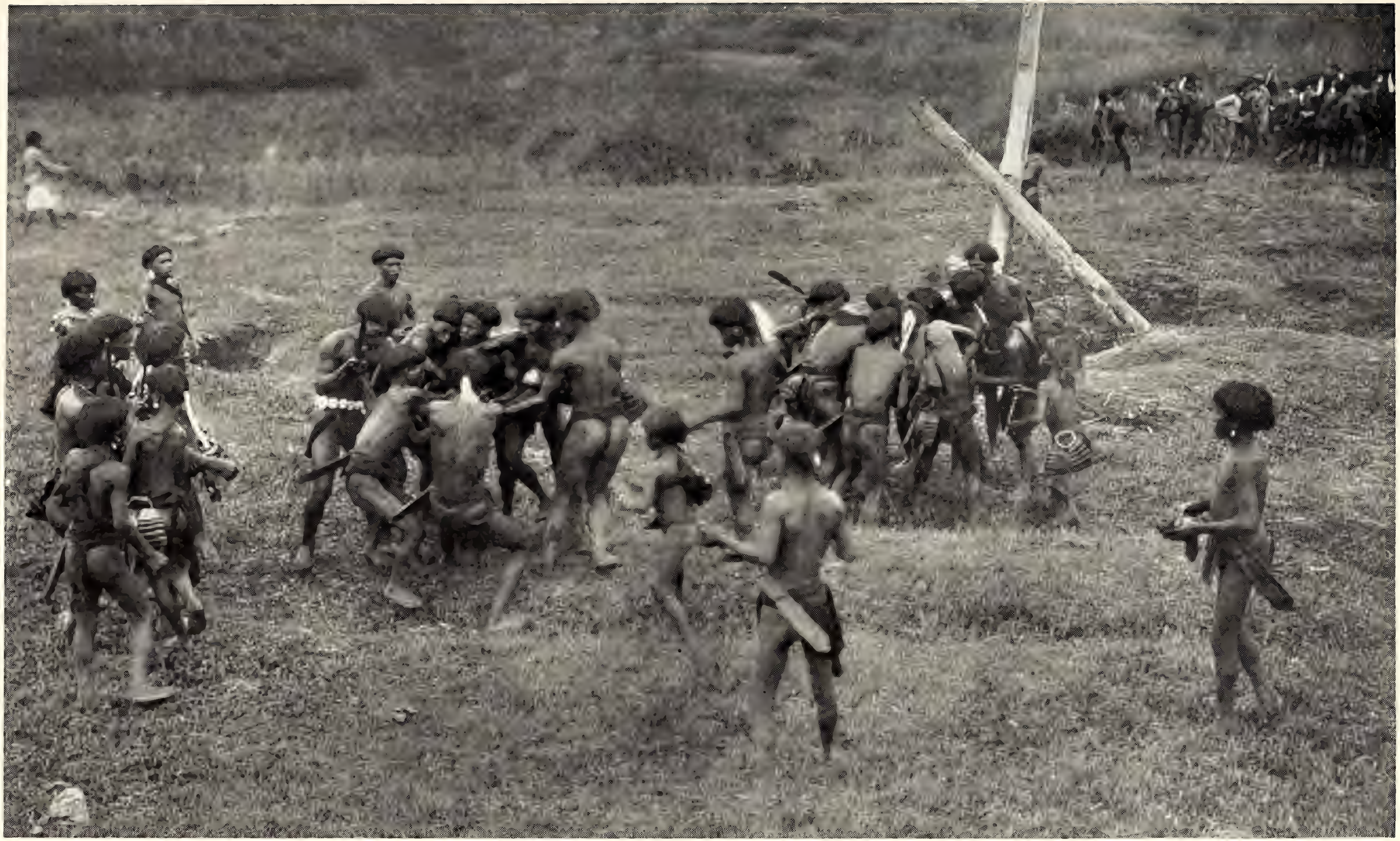
Note that almost every man is expectantly flourishing a bolo



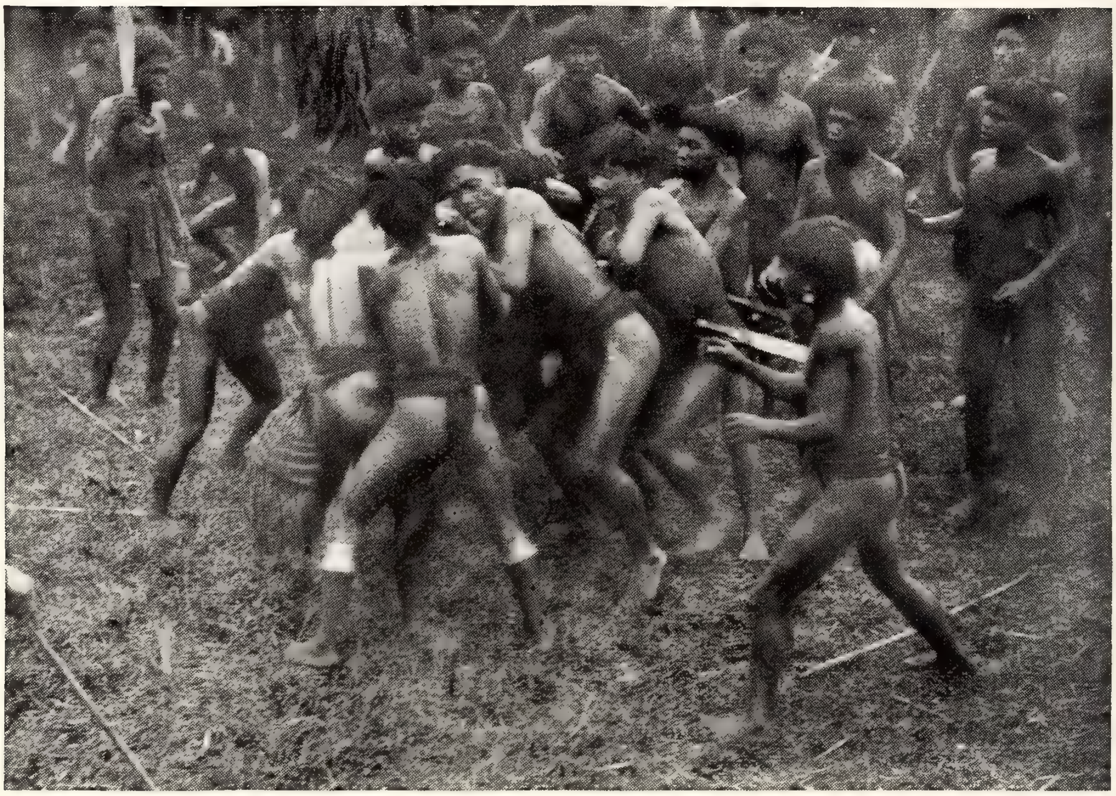
AN IFUGAO CHIEF PRESENTING A CARABAO TO HIS FRIENDS WITH THE WORDS "HELP YOURSELVES"



"Some men lie flat on the ground and cut and hack; on these others kneel, chopping away for dear life, while those who stand farther back bend forward and strike with their bolos" (see page 259)



FIGHTING FOR PIECES OF THE CARABAO: THE MAN ON THE EXTREME RIGHT HOLDS A GENEROUS PIECE AND IS WATCHING FOR AN OPPORTUNITY TO SNATCH SOME MORE



FIGHTING FOR A SINGLE PIECE OF THE CARABAO

him loose, and insist that he shall be killed with an axe. The Ifugaos agree to make this concession to American prejudice. He is knocked down and the usual scrimmage follows. Meanwhile the men wounded in the first melée have come to have their cuts sewed up and bandaged, for they have already learned to have great confidence in the white man's medicine and surgery. They are sure that we must be good Ifugaos and brothers, because we are willing to do them this service. Before we have finished with the first lot of wounded, hundreds of men and women are squatting around us and showing their appreciation by singing to us the Ifugao love song.

One after another the carabaos meet their fate, and one after another the different delegations go marching off to the tune of *gansa* music, each taking with it a goodly supply of meat for women and children at home, who perhaps may never before have tasted any.

The next day we continue our journey, dropping down from the mountains to the Christian town of Bagabag, in Nueva Vizcaya, escorted all the way by Silipan Ifugaos, who were the terror of the Spaniards; who annihilated an entire garrison at Payoan, on this very trail; who exacted a heavy annual toll of heads from the people of Bagabag, and who made the main trail from Nueva Vizcaya to Isabella so dangerous that three strong garrisons were constantly maintained on it, and that people were not allowed to travel over it except under military escort, and even so were often attacked and killed.

At Bagabag we receive an enthusiastic reception. The people of this town are more than grateful, because the government has made their lives and property safe. They will tell you that the Ifugaos believe the Secretary of the Interior, Lieutenant Governor Gallman, and Lieutenant Meimban to be genuine gods, recently reincarnated. In no other way can these Christian Filipinos explain the fact that we have been able to cause 120,000 head-hunters to give up head-hunting and to leave them in peace! In point of fact the Ifugaos believe nothing of the sort, but they *are* convinced that we are pretty good Ifugaos, and they have the best of reasons for knowing that we are their friends.

We have been able to get results in dealing with wild men by following the simple policy of always giving them a square deal; by not punishing them for a given course of action unless they had had ample previous warning that such action would be followed by punishment; by never failing to punish them when, *after due warning,* they have misbehaved; by making friends with them again whenever they were ready to be friendly, and by finding an outlet for their superabundant animal spirits in rough but innocent field sports.

IN HONOR OF THE ARMY AND AVIATION

THE sixth annual banquet of the National Geographic Society, which was held on January 14, was probably the most notable banquet in the history of the Society. In addition to the President of the United States and the ambassadors of Great Britain, Germany, Mexico, and the Ottoman Empire, there were members present from 37 States and from many foreign countries. The dinner was in honor of the United States Army and of the discovery of the art of aviation, the principal guests of honor being the officers of the Army and Mr. Wilbur Wright. Announcement was made during the evening of the election of President Taft as honorary member of the Society in recognition of his effective promotion of and interest in geographic science. The Society now has five honorary members, as follows: William H. Taft, Theodore Roosevelt, Robert E. Peary, Fridtjof Nansen, and George Dewey. Mr. Henry Gannett, President of the Society, presided, and Gen. John M. Wilson, formerly Chief of Engineers, U. S. Army, acted as toastmaster.

Through the courtesy of the Department of Agriculture, the guests and members of the National Geographic Society had the opportunity of testing a new plant recently introduced by the explorers of the Department. The new vegetable was the dasheen, which, instead of potatoes, was served with the filet of beef. The dasheen is one of the principal foods of rich and poor in the Orient, the Pacific Islands, Africa, and the West Indies. By many connoisseurs it is preferred to the potato. The introduction of this popular tuber is important, because the plant can be grown throughout the Southern States and as far north as Washington. It is capable of becoming a profitable industry on many lands which are too wet for the growing of potatoes. The office of Foreign Seed and Plant Introduction of the Department of Agriculture will be glad to give information to all persons interested in this newly imported vegetable.

The addresses of the evening are printed in full as follows:

PRESIDENT GANNETT

It gives me much pleasure to welcome this gathering here tonight. It is true of all societies that the membership moves slowly at first, but lately the Society has been growing by leaps and bounds. A year ago the membership numbered 53,000. Today it numbers 74,000—an increase of 21,000 in a year. It publishes a monthly magazine, and those who are competent to judge say it is a very good magazine. It maintains a course of weekly lectures here in Washington, and those I know are good, because they are always crowded every night and people are turned away. It has given a number of medals for achievement in geographic science and exploration. It has sent an expedition to Alaska to explore the mountains and volcanic regions and scenic phenomena. And, finally, it gives an annual banquet. Now, ladies and gentlemen, I have great pleasure in introducing to you the toastmaster of the evening, General Wilson.

THE TOASTMASTER, GEN. JOHN M. WILSON

Mr. President, Ladies and Gentlemen: In a long military life of over 55 years

DASHEENS DUG FROM A SINGLE HILL AS THEY LOOK BEFORE COOKING

in the service of my country, many honors have been conferred upon me, but none have been greater than that of having been selected as toastmaster at this superb gathering of beautiful women and eminent men.

Modern war demands that campaigns shall be short, sharp, and decisive, and we are looking forward to the happy millennium when the speeches of toastmasters shall be of the same character.

In presenting the distinguished speakers of the evening I shall detain you but a few minutes, for I have learned the lesson of brevity on such occasions from eminent authority.

During the two administrations of that magnificent citizen and statesman, the late President Cleveland, whose constant thought was for the welfare and prosperity of this nation, I was honored by being selected as his military aide; and, on one occasion, when he was about to send me off on a duty requiring tact and diplomacy, he talked with me for nearly half an hour, fully explaining his views on the subject. Rising to leave him, I had reached the door of the library when he called, "Colonel!" Turning and saluting, I answered, "Yes, Mr. President." Whereupon he added, "Let the other fellow do the talking." That is what I propose to do tonight.

Again, while Superintendent of the United States Military Academy, on one occasion I invited that wonderful humorist and raconteur, Mark Twain, to visit West Point and address the cadets. He was my guest at my home, and, at dinner, being desirous of finding out how long he would talk, so that I might give the necessary order as to the hour for sounding "tattoo," I said to him, "Mr. Clements, about what time tonight will you finish your address?" With that inimitable drawl so well known to his friends, he replied, "That depends, sir, upon how long you take to introduce me. Some fellows take half an hour." I promised him I would not exceed three minutes, and I propose to keep myself within the same limits tonight.

We have with us this evening the Ambassador from the great Empire of Germany, a nation renowned for its achievements in peace and war; a nation which has reached the highest round of the ladder of fame in the arts and sciences—in fact, in everything that represents the highest culture; a nation

THE DASHEEN IS A HANDSOME PLANT WITH ITS LARGE SHIELD-SHAPED LEAVES

A FIELD OF DASHEENS IN SOUTH CAROLINA

which has given to the world such superb soldiers as Frederick the Great and von Moltke; a nation whose great Emperor has managed the affairs of state so grandly, and who, although inheriting from his noble ancestors all the qualities of a splendid soldier, has nevertheless done so much towards maintaining peace in Europe during the past decade.

It gives me pleasure to present to you His Excellency Count von Bernstorff, the Ambassador from the Empire of Germany.

THE GERMAN AMBASSADOR, COUNT J. H. VON BERNSTORFF

Mr. Toastmaster, Ladies and Gentlemen: I wish to thank you most sincerely for the kind invitation to this splendid banquet. We diplomats in this most hospitable of all countries of the world become experts in banquets, so that if I say it is a splendid banquet I hope it will convey the superlative to you. It is a great honor and a pleasure for me to meet here tonight one of your most celebrated compatriots—a man who has done more than anybody else in the world to promote aviation.

There is only one disadvantage for us ambassadors, if we are honored and have the pleasure of attending a banquet like this, and that is that we have to earn this honor and pleasure by making a speech. Now making a speech is not so difficult if one knows what one has to say. I do not mean to say that we ambassadors know nothing at all, but those things we do know we are generally supposed not to speak about; and it so often happens that we speak about things of which we know nothing. But I must confess that I never in my life have been asked to speak upon something I knew so little about as now, when I have been asked to speak about aviation in Germany, of which I know positively nothing.

The only experience which I ever had and which promoted my knowledge of aviation was not in Germany, but in America, about two years ago, when the long debates about the tariff kept us diplomats here in Washington until about August. Our principal form of recreation was to go over to Fort Myer and see our distinguished fellow-guest of this evening preparing for his test flight. I remember one day very well that he was kind enough to show me his machine in all details. I tried to understand as much as I could; but, to my great humiliation—we must not have been alone when he was teaching me—I remember the next morning seeing in a local newspaper that Mr. Wilbur Wright had tried to explain his machine to the German Ambassador, who did not seem, however, to understand anything about it.

Speaking of aviation in Germany, I may say that it has developed of late very much, which is perhaps sufficiently proved by the fact that Prince Henry, the brother of our Emperor, has gained a certificate as a pilot. One other proof out of many recollections I can give of the development of aviation in Germany is that only eight years ago I was coming home from a trip in Switzerland, and we crossed the Lake of Constance. When we came to the shore I saw a very great garage, which nobody seemed to know the use of. There was one person on the ship who was clever enough to tell us that that was a garage in which a mad fellow named Zeppelin was building a ship in which he hoped to be able to travel in the air. Last year, only eight years later, when I came across that same lake, I saw this same supposed madman crossing over the lake with about 20 people in his airship.

Germany has been particularly successful in developing the type of airships which are known under the names of Zeppelin, Parsival, and Gross. In the beginning the Zeppelin airship, with its rigid envelope, created the greatest enthusiasm, but since a reaction of public opinion has set in on account of several accidents which these airships have suffered. I believe, however, that this reaction is not justified. In consequence of the first successes which these airships had, the great aëronauts forgot that today the success of a trip in the air is dependent on good weather. They started several times when the weather conditions were not satisfactory, and the results, as you know, have been several accidents. But it is to be hoped that in future, when more garages have been built and people are more careful, such accidents will not happen again.

In former times there were two names in Germany whose bearers have done much to promote the cause of aviation. One is Gottlieb Werner Daimler, who constructed the first light motor to be used in airships. Without these motors flying would have been impossible.

The other was Otto Lilienthal, of whom I can perhaps say a few words without being afraid of having it said by our distinguished fellow-guests that I have been talking nonsense. Otto Lilienthal was one of the first experimenters who used a flying machine. He constructed a very simple machine with canvas and wooden wings, and started first to dart down hills, and afterwards tried to fly through the air. These wings were at first perfectly straight. But later on, by observing the flight of birds and continuing his experiments, he found that it was necessary to curve these wings; and, after having made this experiment, he managed successfully to fly for several hundred yards. In one of these flights he died. But he wrote many essays on aviation, and I think I may say that his essays have been read and have been followed by the most successful aviators of today.

Now my knowledge about aviation is really at an end. So I will sit down, thanking you again most sincerely for your kind invitation to spend this charming evening with you.

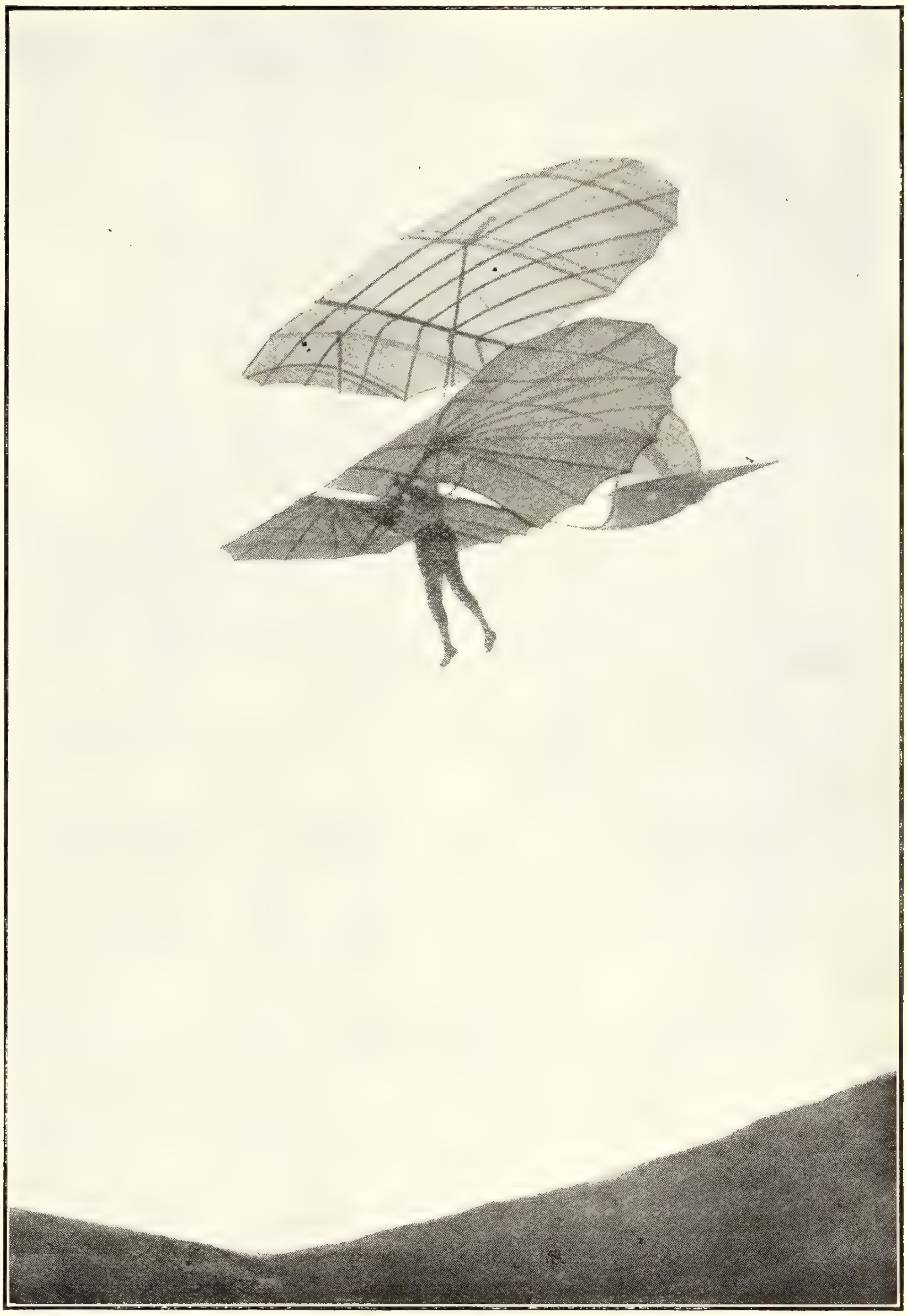


Photo by Prof. Robert W. Wood, Baltimore

OTTO LILIENTHAL MAKING ONE OF HIS LAST GLIDING FLIGHTS

THE TOASTMASTER, GEN. JOHN M. WILSON

It has been my good fortune for the last few hours to be sitting with the most charming gentleman I have met for a long while. He represents our neighbor republic down along the Rio Grande—the land of sun and flowers; the land whose mountains and hills are filled with gold and silver and whose fertile valleys produce the most delicious fruits; the land of beautiful women and brave men; the country whose magnificent President has done so much for its development. It is my pleasure to present to you tonight the Mexican Ambassador, Senor Don Francisco Leon de la Barra.

THE MEXICAN AMBASSADOR, SENOR DE LA BARRA

Mr. President of the United States, Mr. President of the National Geographic Society, Ladies and Gentlemen: A very great honor has been conferred upon me in the invitation extended to me by the National Geographic Society to speak at this banquet in the presence of the President of this Republic, that great citizen, the worthy representative of the American people, who has won, in the high office he fills, the respect and esteem of all.

One cannot but admire the energy applied by this Republic, not only to the development of industry and commerce, but also to the progress of science that to so great an extent serves as the valuable aid of trade.

Among other sciences is that to which your association is devoted, a society well deserving the name of "National," because of the lofty spirit with which it harmonizes the teaching of the wise and its love of the mother-land, for whose greatness the Society unceasingly strives.

The topic which I am to discuss—"The great commercial routes of the world"—is of so vast a scope that it would be impossible for me to do it justice, even superficially, in the short time I may be allowed to occupy your attention this evening. I shall therefore limit my address to general considerations which I may be permitted to lay before you.

In the present day the science of geography is not merely a universal *cicerone,* as it was formerly considered, confining itself simply to a description of the earth's surface and its inhabitants, without bas-reliefs or color, if I may be so allowed to express myself. It has become the most suitable means of acquiring a scientific and practical knowledge of the material and social life of nations. The object of some of its studies is the solution of problems in regard to those great commercial routes of the world which have been selected for the purpose of, or rather because of the need of, shortening distances between the producers and consumers, lessening thereby the cost of transportation to the benefits of all concerned.

Thus we find in the world's history that the paths marked out by navigators and explorers who were led on by thirst for glory, or by love of the mother-land, or by the idea of promoting the welfare of humanity, have been followed by commercial people in search of wealth by exploiting or obtaining new markets.

To these tendencies, which within their proper limits we welcome as motives for the progress of humanity, is due the great movement of expansion and colonization, which began in the sixteenth century and goes on today more actively than ever.

To the financial problems, the solution of which is sought for in the lower prices and rapid transportation of merchandise, we must add other politico-social problems of no mean interest.

The Mediterranean route, which brought together India and England, has not been of benefit to commerce alone. Politics has also taken a most useful advantage of the great historical route of the Suez Canal, the influence of which has been universally felt.

The Isthmian Canal, thanks to which the eastern and western coasts of this continent will be in closer touch, not only will be of benefit to the commerce of the United States with the extreme Orient and with the South American republics, but also to the whole world. It is but natural, then, that the advantage to be derived from these great commercial highways should be felt in the most remote countries as well as in those in closer proximity to the new route.

By shortening the time necessary for transportation, both near and far lands will be benefited by lower freight rates, to the advantage of both industry and commerce.

THE ADVANTAGES OF THE TEHUANTEPEC ROUTE

The interoceanic problem in our continent was clearly defined in the first half of the sixteenth century by the Emperor and King, Charles V, and by Hernan Cortés, the conqueror. In a letter, a most interesting document in many ways, the Spanish monarch urged Cortés to do all in his power to find a route that would connect the eastern and western coasts of the New World. The captain, in reply, gave great hopes of success, adding that this would make the King of Spain lord and master of so many kingdoms that he might be properly called King of the World. This was in the year 1533.

In the midst of his occupations as warrior and governor, Cortés tried to find this passage, and explored the Coatzacoalcos River to its head-waters in the Isthmus of Tehuantepec. Finding no opening, but being aware that commerce in a more or less distant day would pass through this low, narrow region, he asked for and was granted by the Spanish Crown a concession of lands in that region, where, in his belief, the outlet would be eventually opened. His descendants still continue to hold the lands, which formed part of the marquisate of the Oaxaca Valley granted to the Conqueror.

When Baron von Humboldt visited Mexico he understood at once the great importance of the Isthmus of Tehuantepec for the commerce of the world, and gave a graphic form to his idea by calling this part of our country "The Bridge of the World."

Tehuantepec and Panama are destined to be the great highways of our continent.

"Mexico," says the eminent Reclus, "is destined to play a prominent part in the future of humanity. The Isthmus of Panama, soon to be changed to a strait, is one of the historic routes of the future; the Isthmus of Tehuantepec is also marked as one of the routes to become of universal importance."

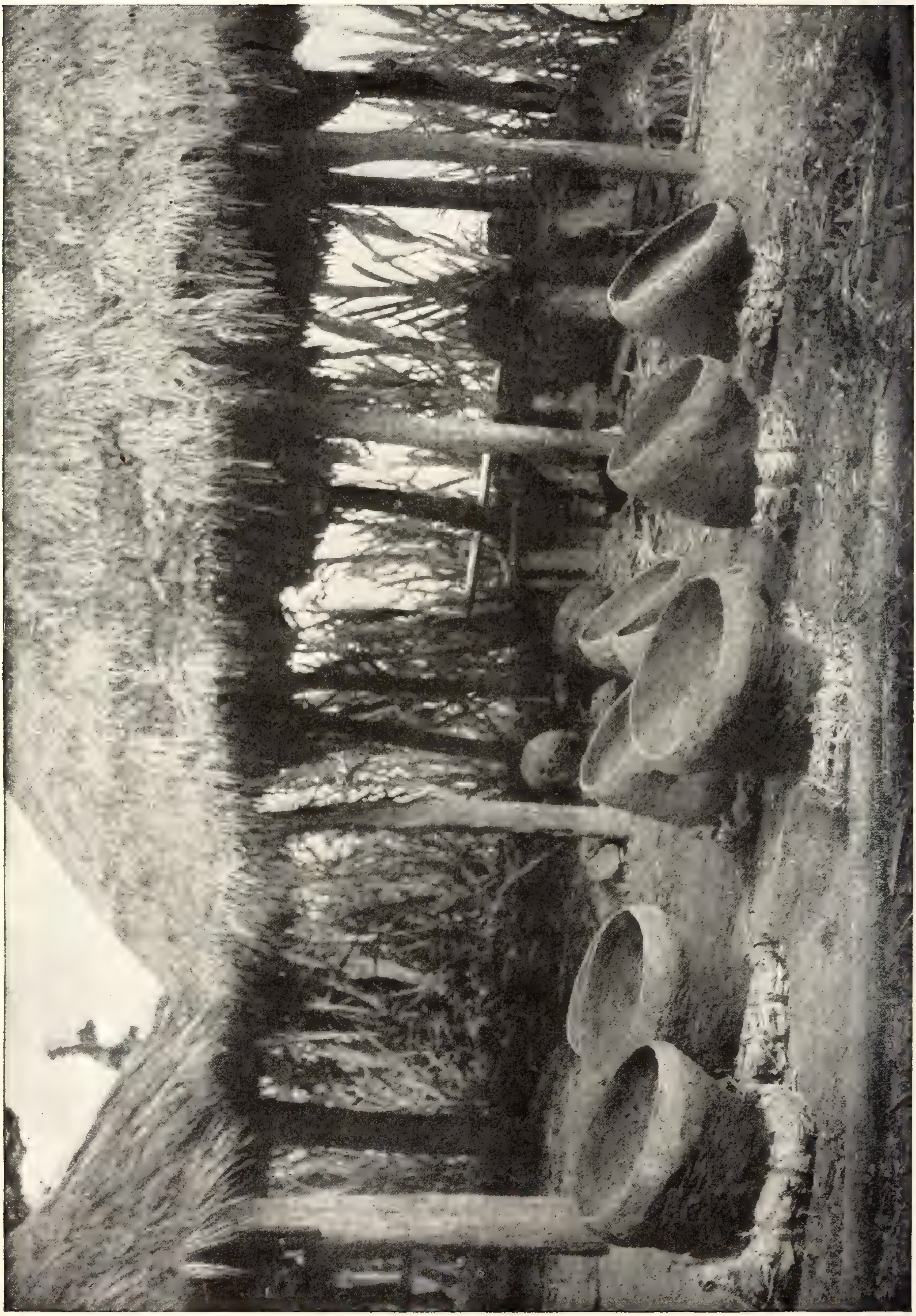
Tehuantepec already affords rapid means of transportation for passengers and merchandise by the railway, 190 kilometers in length, lying between Salina Cruz, one of the best ports of the Pacific, and Puerto Mexico, formerly called Coatzacoalcos, where the great port works are nearly completed and ships drawing 30 feet of water may enter freely.

The 16,200 miles separating Liverpool from Auckland, in New Zealand, have been reduced by the Suez Canal to 14,600 miles, still further reduced by the Panama Railway to 13,200 miles, and to 12,800 by the Railway of Tehuantepec.

The Mexican government has left nothing undone to supply the terminal ports of this route with all possible means for facilitating rapid transit for both passengers and freight. The great success attained has shown that the foresight upon which the action of the government was based was prudent and justifiable, and that, thanks to it, the commerce of the world receives from this interoceanic route benefits of notable utility.

You, members of the National Geographic Society, have done a good work As the efficient aids to a sound and prudent diplomacy, which strives for the maintenance of harmony among nations by the force of justice, you, I say, labor to the end that nations may better know each other, and proffer the service of science to this noble aim. This is of the greatest possible importance, because one of the grand problems of the present moment is that of conquering the prejudices that keep apart peoples of different races.

For this reason, members of the National Geographic Society, you not only deserve praise from scholars for your scientific and practical work, as shown in part by your most interesting magazine, but you should also be entitled to the gratitude of statesmen for your valuable aid in the harmonizing of international policies.



PRIMITIVE POTS FOR MAKING SUGAR IN THE INTERIOR OF COLOMBIA

THE TOASTMASTER, GEN. JOHN M. WILSON

Honors are heaped upon us tonight. We have with us that noble and distinguished statesman, that wonderful writer, that accomplished gentleman who represents the great Kingdom of Great Britain, upon whose dominions the sun never sets; that kingdom which has produced some of the greatest of soldiers, some of the greatest of statesmen. It gives me pleasure to present to you the Right Honorable James Bryce, Ambassador from the Kingdom of Great Britain.

THE BRITISH AMBASSADOR, HON. JAMES BRYCE

Mr. Chairman, Ladies and Gentlemen: I did not come here with any intention of addressing you. I knew that you had already a program which would be amply sufficient for the time, and I had really nothing to say, which, however, is the smallest reason that ever is assigned for not making a speech. But I came because it is always a pleasure to me to be in a company of geographers who represent in a very large sense the whole world, their nature being that of making the people of every part of the world know the people of every other part of the world, and thereby bringing about that good understanding which is the basis of international peace.

There is only one observation which has occurred to me as I am thus suddenly called to my feet. It is suggested by the journey from which I have just returned in the Southern Hemisphere. It has always seemed to me that the one dark cloud on the horizon of our geographers, the one drop of bitter which prevents us from enjoying the draught of knowledge which is raised to our lips by every successful geographer, is the sense that this planet of ours is limited, and that in time we shall have exhausted all its resources as far as exploration is concerned. We are accustomed to take large views of time as well as of space, and we do not want so to define and dispose of the whole earth as to leave nothing for the many generations that are to come after us—as I believe the astronomers allow us several millions of years until the changes in the solar system will bring this earth and its population to an end.

Well, I received some consolation in visiting South America from this nightmare of a sense of exhaustion which sometimes arises in the minds of geographers, because I found in traversing South America that there is still a vast deal left that the geographical explorer has to do. And I should like to call the attention of those aspiring spirits among you who wish to associate your names with further discoveries to the opportunities which that great continent offers.

Of course, these are no longer the days of the most sensational discoveries. We cannot have anything to look forward to like the discovery of the Pacific Ocean or the North Pole or the Grand Canyon of the Colorado River. But still there is a vast deal of useful geographical work to be done, particularly in the center of the South American continent. There are regions in the eastern part of Bolivia and Peru, and in the western parts of Brazil, and in the adjoining parts of Argentina, Venezuela, Colombia, and Equador, which are practically unknown, and where an immense deal is to be done, not only by the naturalist, the biologist, and botanist, but also by the simple explorer, in determining the course of rivers, the heights of mountains, and in ascertaining the resources of the country.

At present there are two forces at work in exploration; the one is that of the railway projectors, who are laying out lines, some of which will be completed and some of which will have to wait a good while for completion, and perhaps a longer time still before they afford an adequate return to shareholders. And there are also the people who are exploiting the resources of the country and who are more concerned with making profits than with scientific discovery. Now there is a great field for the scientific explorer. There are no countries in many ways more interesting than these countries as regards the grandeur and the peculiar character of their scenery, and as regards the extraordinary spectacle presented by the unexampled and exuberant resources of nature. I do not think anything in the world is more striking than the resources of nature as in a South American forest.

Therefore I can console you by telling you that there is still a great deal remaining for geographers to do, and that there is a field open to any geographer who will devote himself to that continent. We in Great Britain have sent thither many explorers, and I hope we may send many more. You here I hope will join us in this effort. In the remoter part of these countries the idea of exploring for purely scientific purposes has hardly reached the peasantry. Everybody is supposed to be looking for mines hidden in the days of the Incas. But if you will play your cards judiciously you may for a time at least facilitate your searches.

Ladies and gentlemen, let me thank you for the opportunity of being present among you this evening. Let me tell you that in addition to the enjoyment you will have if any of you go there in adding new realms to knowledge, you will also have one of the greatest pleasures that the poetical and philosophical mind can enjoy, in contemplating these scenes of nature, which open much that is not to be paralleled elsewhere, which give one a lively sense of what that magnificent continent will become when its resources have been further developed.

THE TOASTMASTER, GEN. JOHN M. WILSON

The honor seldom comes to a soldier to present such a magnificent body as this to his Commander-in-Chief, as I propose to do in a very few minutes. We have with us the President of the United States, a man who has never failed in any duty, who has won the love and respect and admiration of the American people without regard to politics, who today stands before the world as a great and magnificent chieftain of a nation of 93 million people within its own limits, and who waves the American flag over 8 million more for their protection. It gives me pleasure to present this Society and its guests to the President of the United States, whom we also greet as one of the five honorary members of the Society.

THE PRESIDENT OF THE UNITED STATES, HON. WM. H. TAFT

Ladies and Gentlemen of the National Geographic Society: It is always a great comfort to be at a meeting presided over by General Wilson. He conducts it as a military man. I have always thought that even the Speaker might learn something from General Wilson, and I commend him to Brother Champ Clark as to how to carry on a deliberative assembly.

I am very much honored to be made an honorary member of the Geographic Society. I do not think I deserve it, but not for that reason will I decline the honor and the membership.

One has a constant source of regret for what he loses as he sees the opportunities pass by in life. As I stand in this presence and look at Mr. Grosvenor, I am constantly reminded of the valuable information that he is giving to the public through the Geographic Magazine that I have to pass over because I do not have time to read it; and if this association is maintained for the purpose of carrying on that Magazine, I am sure it can justify its existence.

The British Ambassador has referred to a number of places to which the National Geographic Society might direct its attention. I wish to add two more. One is Sumatra and the other is the Philippines. We are doing a good deal in the Philippines in the way of attempting to develop that country, but there is a great opportunity for a scientific survey of the islands with respect to a great many data that would give us exact information that we do not now have. In the enthusiasm of a desire to do everything in the Philippines at once, I suggested and urged the passage of a bill for the appropriation of $10,000,000 to make an investigation in those islands, and make them complete according to scientific ideas. But after I had found a great deal of difficulty in getting two or three millions out of the government for the purpose of helping us along with our education and with other things, I concluded that that sort of a survey was in the nature of a luxury and might be postponed for many years; but luxuries are to be reached through private contributions. We in this country depend on the generosity of our millionaires for doing the things that we do not think the government ought to do, and I suggest that one very useful place in which to spend the income from these $10,000,000 funds that are being distributed with such a lavish hand would be a scientific survey in the Philippines.

Another thing I should congratulate the National Geographic Society upon is that Congress is taking slow steps—but I hope sure steps—to recognize in an appropriate way the man who went to the North Pole. You who are scientific members of this body understand the value of what he did, and all of us who have read can understand the tremendous labor that he undertook and the amount of inconceivable endurance that he had in winning that place, which, when we find it, does not seem to be particularly useful except by way of satisfying what had theretofore been a most dangerous curiosity. I sincerely hope that Congress will recognize the fact that Commander Peary has done something of which every American ought to be proud, and which, if he had been an Englishman or a German or a Frenchman, would have been long ago recognized by a promotion to some permanent honor and by something more substantial that would have enabled him to enjoy that honor without working.

Now, my friends, I did not intend to make a speech any more than Ambassador Bryce; but I cannot close without making a remark or two in respect to something in which the National Geographic Society is deeply interested, because when it is completed it will change geography and it will make the Atlantic and the Pacific oceans very much the same. Ambassador Bryce visited Panama two or three weeks before I did. He sent me some suggestions with reference to the geological investigations that ought to be made there; and, having the power without consulting Congress to send a geologist there, I did so. And he discovered a condition of things on the Isthmus that will certainly be most interesting to geologists and is certainly most valuable to us in the construction of the canal with reference to the slides that may be anticipated in the deep cut at Culebra.

I am glad to be able to say that the work is going on and that quite a number of months before January, 1915, I hope, we shall have straits cutting through the Isthmus, for the canal will be 300 feet wide in the narrowest part and will in almost all its length be 500 to 1,000 feet wide. We shall have straits there that will carry out the idea that was conceived in the time of Charles V, when the Isthmus was first discovered. It has taken 400 years to carry out that idea, and it must thrill through the veins and the nerves of every American to go down there and see that work and realize what this country is doing there with the aid of its army engineers and with the organization which moves as one machine through 40 miles to cleave that isthmus and make it an instrument of commerce between the oceans. I thank you.

THE TOASTMASTER, GEN. JOHN M. WILSON

We have heard from the Chief Executive of our nation, from some of the superb ambassadors from foreign countries, and now we turn to the Army of the United States. It gives me great pleasure to present to you a soldier and a scientist, a man who has given magnificent service in the Indian country, whose service in the Spanish war was great not only from a military point of view, but as an executive officer, and who afterwards did even more superb work in the

Philippines. I present to you Maj. Gen. Leonard Wood, the senior officer on the active list of the United States Army.

MAJ. GEN. LEONARD WOOD, CHIEF OF STAFF, U. S. ARMY

Mr. Chairman, Mr. Toastmaster, Ladies and Gentlemen: I have had the good fortune tonight to sit beside Mr. Wright, and I have tried to pull a little information out of him about his work with the Army. But those of you who know him know that he is so modest and so reticent that to get information out of him is a good deal like mining, for you have to work it out in little pieces. He is the father of aviation in our Army. He has instructed a number of our officers in the use of the aëroplane, and he has laid the foundation for a corps of officers skilled in the use of this most useful machine. All of us soldiers look upon the aëroplane as a great addition to our warlike apparatus. We know that its use is going to be invaluable in future wars. As a means of reconnaissance, of locating the forces and dispositions of the enemy, it will be invaluable. Its use is going to be rather hazardous, and as yet I look upon it only as an instrument or means of reconnaissance and for the transportation of messages and perhaps messengers. But there is no doubt, if the rate of progress made the last year or two is continued, that we shall soon have machines working with great accuracy and great speed and carrying two or perhaps three or four people, or the equivalent amount of material, to places which would otherwise be inaccessible. I think the course of the next war, certainly the course of all the larger operations, will be very largely influenced by the knowledge that the enemy will have a machine which will enable it to fly over their lines and locate their dispositions and see where their reserves are, etc.

Now, the work that Mr. Wright has been doing has not received much encouragement from the government. While the governments of France, Germany, and other great European countries have made very large and liberal appropriations for the purpose of instructing their officers in the use of the aëroplane and providing machines for their use, we have one old machine which the chief signal officer told me the other day he thought could be put in working order for seventy-five or eighty dollars. And one of the officers volunteered to put up that amount of money and see if he could get it off the ground again. That is the condition of aëronautics in our military establishment. The officers are willing if the money is forthcoming.*

Some young men scattered throughout the country who own aëroplanes, under the leadership of Mr. Thomas Ryan, of New York, and others, have gotten up a voluntary aëronautical club, and they are working at a plan to organize a sort of aëro-militia, if I may use that term, and put themselves entirely at the disposition of the government. They have recently made application for the use of some of the government land near Washington, and propose to keep a number of machines for the purpose of instructing the officers of the Army, and all of us who are interested in this work are trying to assist them in obtaining the use of a suitable piece of public property. We feel sure that as soon as this work is taken up and the government sees the future of it, that money will be forthcoming, and the United States will be the last in the procession. I thank you very much for your kind reception.

THE TOASTMASTER, GEN. JOHN M. WILSON

Before calling upon the eminent scientist, Mr. Wright, Major General Greely, a distinguished scientist, has a few words to tell us about the experiments of Secretary Langley in aëronautics before his death. I present to you General Greely.

MAJOR GENERAL A. W. GREELY

Mr. Chairman, Mr. Toastmaster, Ladies and Gentlemen: The dinner tonight is in honor of the Army, which gave the first victim to modern aviation through the death of Lieutenant Selfridge, of the Signal Corps. As I would not have you think that the Army is entirely unmindful of what it owes to the civilians of the country, I wish to say a few words in memory of the father of modern aviation, the late Samuel Pierpont Langley.

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* The Congress has since made an appropriation of $125,000 for the purchase and operation of aëroplanes.

When the Board of Ordnance and Fortification of the Army allotted fifty thousand dollars for the purpose of constructing a full-sized aërodrome I was the officer associated with Mr. Langley by being designated as a legal supervisor of the expenditures for that purpose. The history of that work is known. A machine was built. It was ready for testing, but in launching, through accident, it was so injured as to make it impossible to fly, although today it is recognized that the aërodrome was constructed suitably for aviation. As a result there came an abuse and revilement which hastened Professor Langley's death, causing in him a sense of humiliation at the loss of his reputation and at the unfortunate results. People said that he was a dreamer and not a worker. Dreams pass, but work abides, and on the foundation which Langley so well builded has grown up this wonderful fabric of modern aviation.

And I would like to tell you that Professor Langley foresaw this shame and humiliation and possible failure. When I informed him that the money had been allotted and asked him when he would go to work, he took me in his confidence and told me what he thought and what he foresaw. He believed aviation practicable and possible, but he said, "You see what I risk for this work." And, after a week of mature reflection, he took upon himself this great and, as many thought, impossible task. He gave to it the best of his scientific ability. He risked the loss of his reputation. He faced unflinchingly the criticisms and reflections that were made upon him, and, unfortunately, he died before he saw the full measure of success which came from his self-sacrificing work.

I have had fifty years of public service, extending into different spheres and varied in its activities, and I have been familiar with many forms of altruism, but in them all I have never known a loftier note than was sounded by this man when he risked everything that was dear to him, things which he valued more than life, for advancing the interests of humanity, for enabling man to dominate the unknown kingdom of the air. And so tonight I felt that I should like to say a word for this man who dared and who suffered in the interests of science and of the world. Samuel Pierpont Langley was our associate. Now he is our fitting exemplar.

THE TOASTMASTER, GEN. JOHN M. WILSON

The closing address will be made by the distinguished aviator, Mr. Wilbur Wright, and after he finishes I have one word more to say, and then we will close the evening's entertainment. Mr. Wright is believed to be the first successful man in the use of the aëroplane. He has received the medal of Congress and he has received the Langley medal. His career is well known to all, and he stands before you tonight with that clean-cut, pleasing face to tell us what he has done and what he will yet accomplish.

Sixty years ago, as a boy of 13 I attended the old National Theater here and saw a play called "Washington a Hundred Years Hence." There were advertisements on the scenery of excursions to London, going over in the morning and returning in the afternoon, and show-bills telling of excursions to Mars and other planets. I am sure I do not know whether Mr. Wright is going to carry us that far, but I am sure that he will give us an interesting talk. I present to you Mr. Wilbur Wright.

MR. WILBUR WRIGHT

Mr. Chairman, Ladies and Gentlemen: When the Director of your Society extended me the invitation to be present at this dinner he indicated that a few remarks might be required from me. This game of after-dinner speaking is one that I have never played very much; so I said to myself, "It will be a good thing to study up on the rules of the game."

So last week I went up to New York and had an opportunity to attend a dinner there at which were present a number of distinguished speakers. The first gentleman on the program was a bishop, and he made a splendid speech. I said to myself, "If it is necessary for me to speak like that I might as well give up trying to play this game." But as the evening wore on I began to discover things. I found out after a little bit that this man had been stealing the speeches of all the men who were to follow him on the program; and not only that, but, according to the statements of the other speakers, he had not only stolen their ideas, but he expressed them better than they could express them themselves. "Well," said I, "if a man is permitted to steal the speeches of all the other men on the program, it is an easy job." So when I heard that among the speakers this evening were some of our most distinguished men, including the President of the United States, I said to myself, "This will be an easy job. I will steal their speeches and I will present them better than they could present them themselves."

But unfortunately the novice often learns some other rule that is equally as important. In this case the rule I overlooked was the rule that provides an arrangement of the speakers on the program. Instead of being on first, so that I could steal their speeches, I have been put on last, with the result that all the speech I was going to make they have made; and, as usual in banquets, according to rule, they have said it a great deal better than I could say it myself.

But I have discovered one other rule that is customary in this game, and that is to choose the subject which is appropriate to the occasion; and another rule: confine your remarks strictly to the subject. Therefore I chose for my subject this evening "geography." I shall confine my remarks more particularly to that branch of geography which I discovered on the front of a book once in my father's library. The book was entitled "The Geography of the Heavens." I am not certain now whether the book treated of astronomy or whether it was a book on theology. For my part I steered clear both of astronomy and theology; and, in order to keep off the ground that might have been covered in that book, it is my intention to turn the subject exactly upside down, and instead of viewing it from the ground I will view geography from the heavens.

The ways and means of studying the earth from above have now become pretty well known. Some of the uses which may be expected to be derived from the aëroplane and similar instruments have been told you very well by our distinguished friend, General Wood. The real uses of the aëroplane in warfare are so much better known to him and have been so much better presented that I shall not attempt to take up your time with that. The advantages of knowing what the enemy is doing, with the consequent advantage of being able to concentrate your own troops at the critical spot—the advantage of rising high in the air for the purpose of determining the accuracy of gun-power and giving appropriate directions for carrying on work of that kind—are so well known that it is useless for me to take it up now.

The leading nations of the earth are taking up the subject, our own nation being the first of all to begin it. But, unfortunately, there seems to be some hesitation at present. I do not know exactly what the trouble is. I presume possibly that if we were to apply the parable of the talents we would possibly arrive at something near the present situation. The Department probably feels that with the small equipment it now has it is useless to do anything. On the other hand, Congress seems to feel that unless something is done with the equipment already on hand it is useless to appropriate for it now. I hope the day will soon come when more will be done with what we already have, so that Congress will see fit to appropriate more if it sees that the money will be well spent. I thank you very much.

THE TOASTMASTER, GEN. JOHN M. WILSON

Thanking you for your presence with us tonight, I must, before closing the pleasures of the evening, give to you "a wish for you all," which a charming Southern gentleman gave to me a few years ago when with a delightful party we were sailing on one of Maine's most beautiful lakes:

"Sweet as the song which the robins sing,
Pure as the flow of a crystal spring;
Deep as the depths of a mother's love,
True as your faith in the God above;
With a harvest of smiles and a famine of tears,
Through all the course of the coming years,
So sweet, so pure, so deep, so true,
Be the joys fate holds in store for you."

MEMBERS AND GUESTS PRESENT

The committee in charge of the banquet consisted of: Gilbert H. Grosvenor, Chairman; John Oliver La Gorce, F. B. Eichelberger, O. P. Austin, Charles J. Bell, John Joy Edson, David Fairchild, C. Hart Merriam, Henry F. Blount, C. M. Chester, Frederick V. Coville, John E. Pillsbury, Rudolph Kauffmann, T. L. MacDonald, S. N. D. North, Alexander Graham Bell, Henry Gannett, John M. Wilson, J. Howard Gore, A. W. Greely, Willis L. Moore, George Otis Smith, and O. H. Tittmann.

The members and guests present were as follows:

Brigadier General James Allen, Chief Signal Officer, U. S. Army.
Representative and Mrs. Wyatt Aiken, of South Carolina.
Mr. Charles Francis Adams.
Miss Rebecca Adams.
Mr. and Mrs. Geo. C. Altemus.
Major Henry T. Allen, U. S. Army.
Representative and Mrs. D. R. Anthony, Jr., of Kansas.
Mr. J. A. Aspinwall.
Mr. J. C. Aspinwall.
Hon. O. P. Austin, Chief of U. S. Bureau of Statistics and Secretary of the National Geographic Society, and Mrs. Austin.
Representative and Mrs. D. S. Alexander, of New York.
Hon. John Barrett, Director of the Pan-American Union.
Mr. Charles J. Bell, President American Security and Trust Company.
Miss Aileen A. Bell.
Mrs. I. P. Berthrong.
Honorable and Mrs. A. B. Browne.
Senator A. O. Bacon, of Georgia.
Mr. and Mrs. Ira Bennett.
Representative and Mrs. Wm. S. Bennet, of New York.
Mr. and Mrs. Scott Bone.
Mr. and Mrs. W. E. Brigham.
Senator and Mrs. E. J. Burkett, of Nebraska.
Mr. A. B. Bowers.
Dr. and Mrs. Samuel Nelson Barker.
Mr. Henry Bradley.
Mrs. Horace Bentley.
Representative Richard Bartholdt, of Missouri.
Mr. Elbert S. Barlow.
Senator Theodore E. Burton, of Ohio.
Rear Admiral and Mrs. G. W. Baird, U. S. Navy.
Miss Bertha Boody.
Mr. C. E. Borden.
Mr. and Mrs. Claude M. Bennett.
Rev. J. L. Barnhart.
Mr. Herr H. Bruning.
Mrs. Marguerite M. Brown.
Mr. Wm. J. Brown.
Dr. J. Wesley Bovee.
Mr. Ward T. Bower.
Mr. Robert Brott.
Representative W. G. Brantley, of Georgia.
Mr. Adolph L. Bernheimer.
Mr. Oscar M. Brown.
Dr. Pierre Bouery.
Senor Barranco, Cuban Vice Consul.
Colonel and Mrs. Henry F. Blount.
Senator and Mrs. Henry E. Burnham, of New Hampshire.
Senor Don Francisco Leon de la Barra, The Ambassador of Mexico.
Representative Albert S. Burleson, of Texas.
Count J. H. von Bernstorff, The Ambassador of Germany.
Mr. R. de Lima e Silva, Charge d' Affaires of Brazil, and Madame de Lima.
Dr. Francisco Carrera Justiz, The Cuban Minister.
Senor Don J. B. Calvo, The Minister from Costa Rica.
Dr. Frederick V. Coville.
Representative and Mrs. P. P. Campbell, of Kansas.
Major General and Mrs. Wm. H. Carter, U. S. Army.
The Chinese Minister and Madame Chang.
Representative and Mrs. Champ Clark, of Missouri.
Captain Y. O. Cress, U. S. Army.
Mr. Benjamin Carter.
Mr. and Mrs. Melville Church.
Colonel E. H. Crowder, U. S. Army.

Mr. and Mrs. J. D. Carmody.
Brigadier General J. J. O'Connell, U. S. Army.
Mr. Harry Caplin.
Mr. and Mrs. Ernest J. Clark.
Mr. Edward S. Curtis.
Mr. and Mrs. William C. Church.
Mr. and Mrs. Frank G. Carpenter.
Mr. and Mrs. B. N. Clinedinst.
Mr. and Mrs. A. J. Corning.
Mr. and Mrs. William E. Curtis.
Mr. and Mrs. E. B. Clark.
Mr. Reuben Clark.
Major Chas. H. Cole, U. S. Army.
Representative and Mrs. Henry Allen Cooper, of Wisconsin.
Mr. Howard Crawley.
Representative R. H. Cameron, of Arizona.
Miss Marian Cock.
Dr. and Mrs. N. A. Cobb.
Mr. Walter I. Dawkins.
Major Jas. T. Dean, U. S. Army.
Mr. B. M. Des Jardine.
Mrs. Jessie J. Dorphley.
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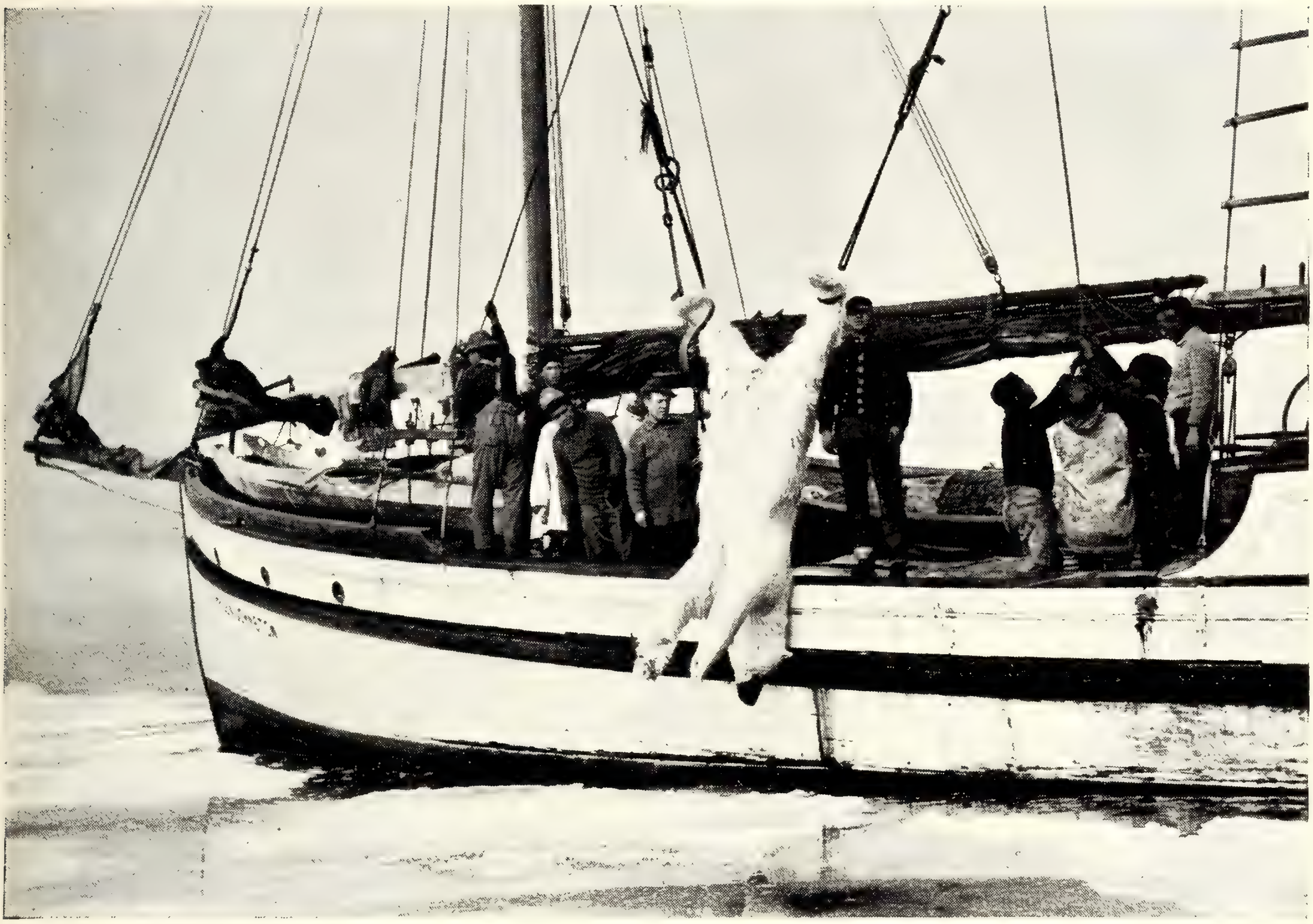
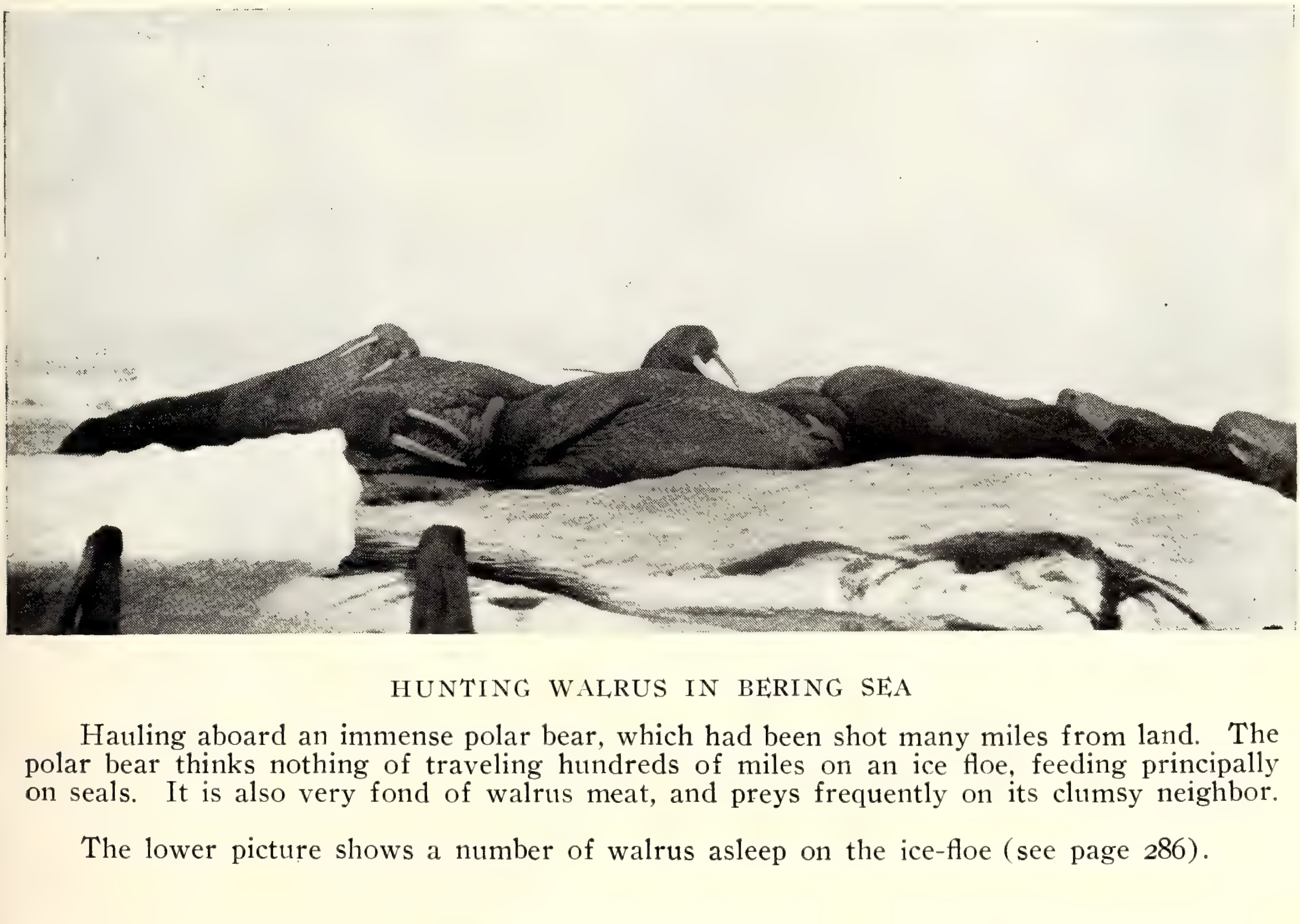
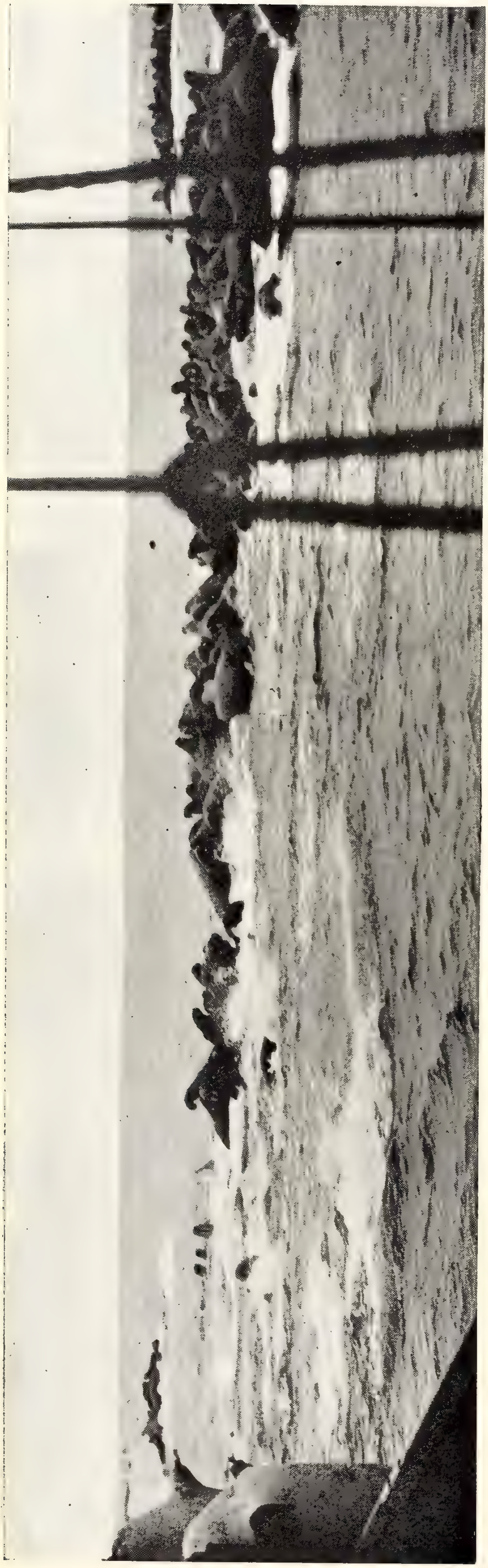




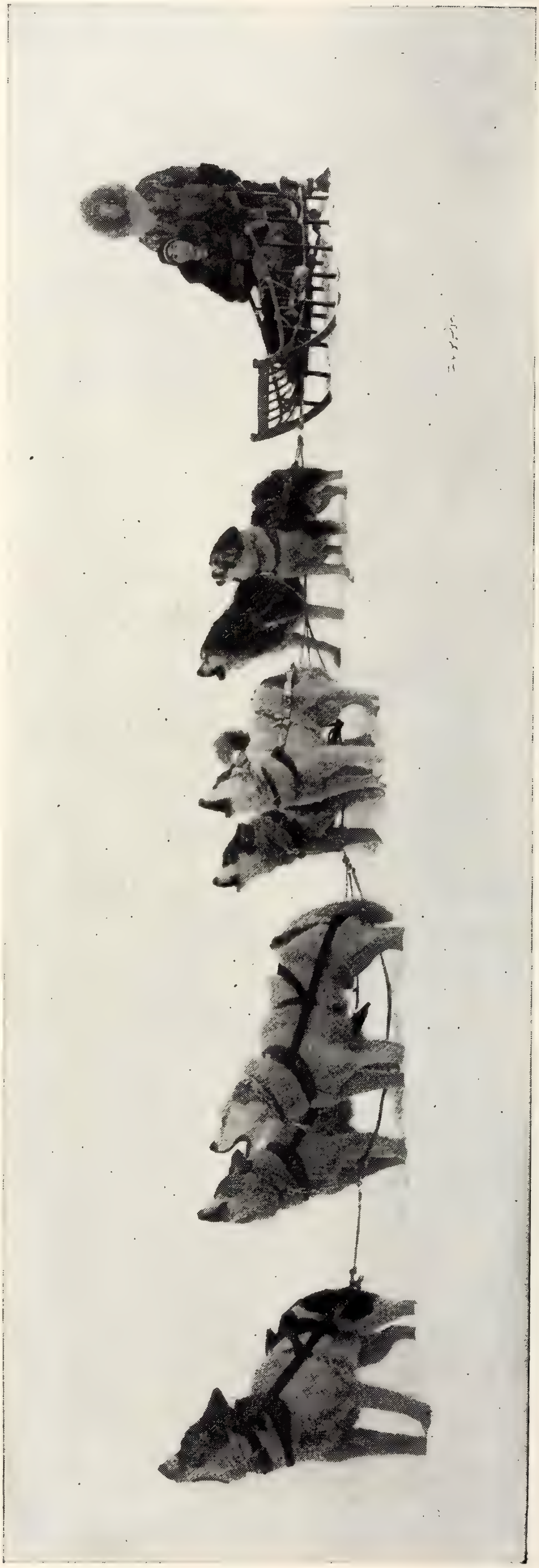
HUNTING WALRUS IN BERING SEA

Hauling aboard an immense polar bear, which had been shot many miles from land. The polar bear thinks nothing of traveling hundreds of miles on an ice floe, feeding principally on seals. It is also very fond of walrus meat, and preys frequently on its clumsy neighbor.

The lower picture shows a number of walrus asleep on the ice-floe (see page 286).

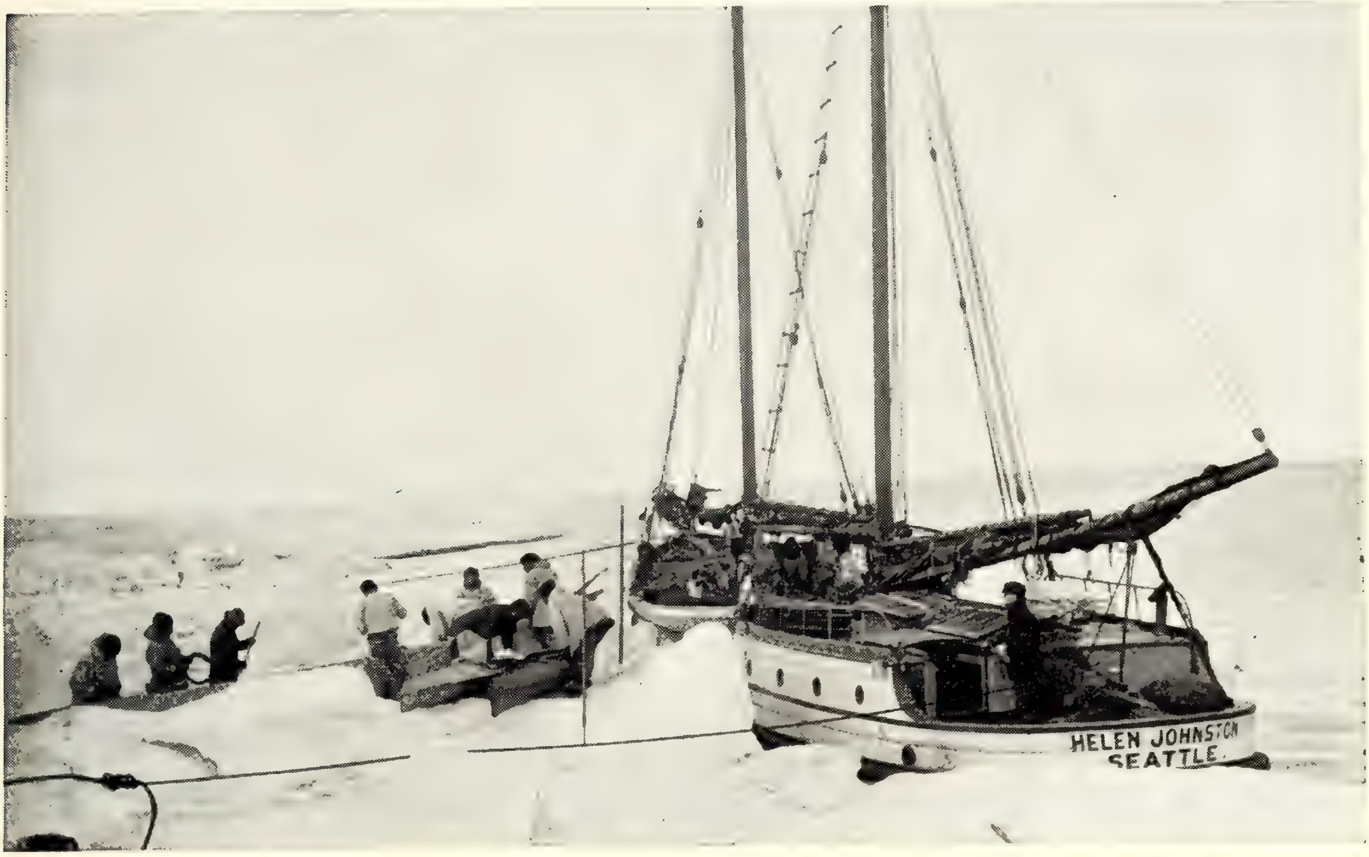


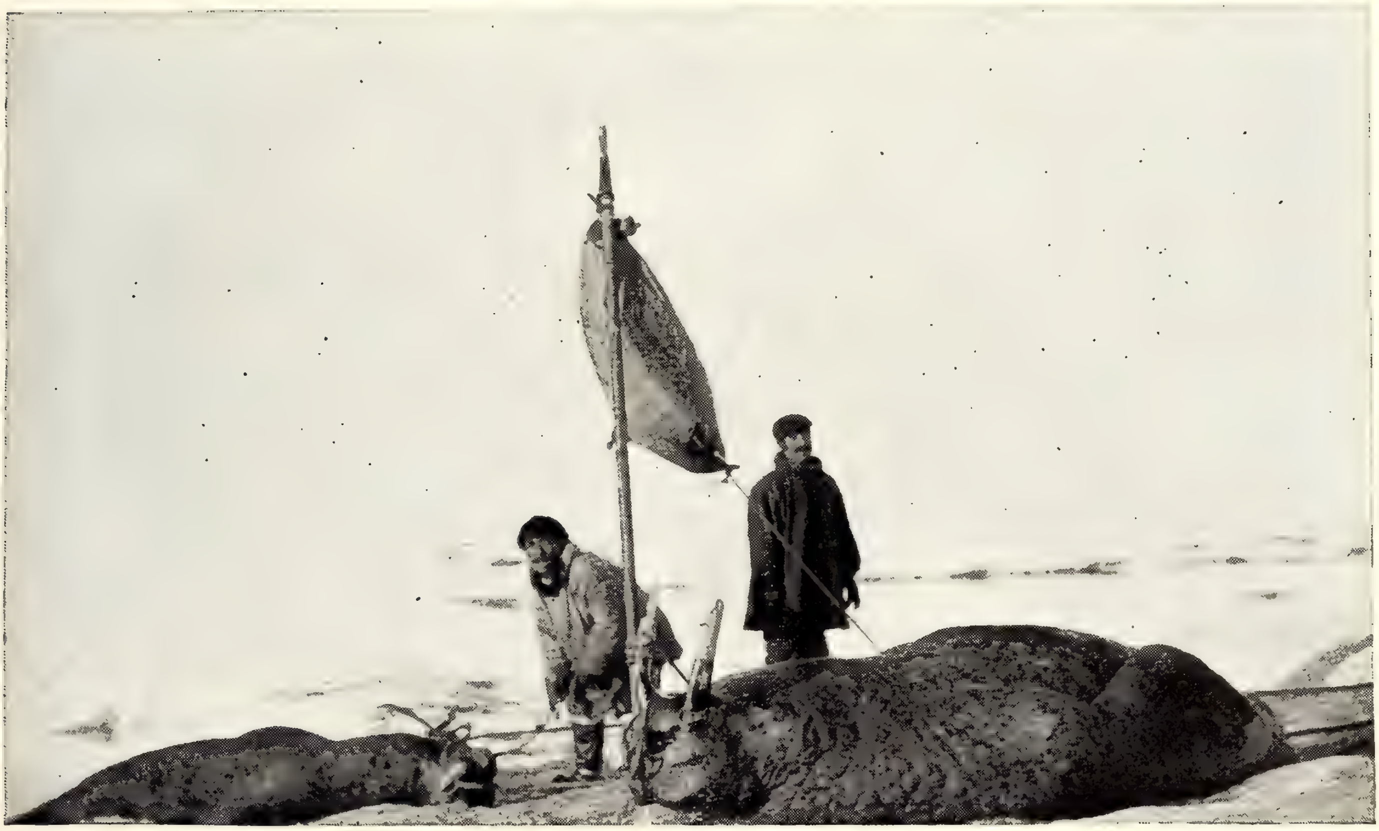
SAILING BY VAST HERDS OF WALRUS IN BERING STRAIT IN THE SUMMER OF 1910



Photos by Dobbs, of Nome, Alaska

THE MALAMUTE CHORUS: NOME, ALASKA





HUNTING WALRUS IN BERING SEA

The upper picture shows the walrus hunters disembarking their boats and skin kayaks. The ship remains moored to the ice floe while the men hunt the walrus from the ice or from the boats.

Walrus that have been killed and are "buoyed" on the ice until the hunters can cut off the tusks. Many, however, of these magnificent animals when shot plunge into the ocean, where they sink before they can be secured.

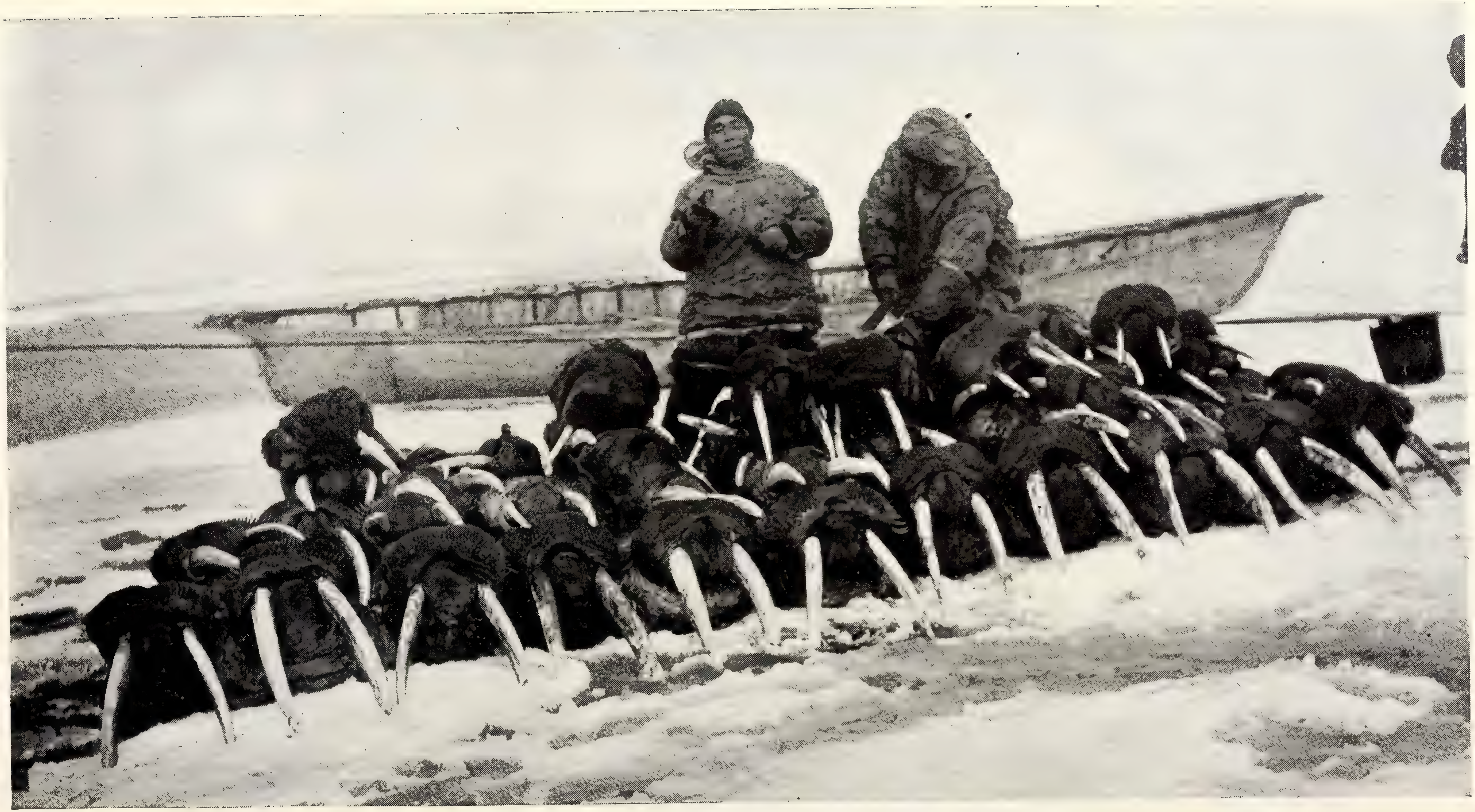
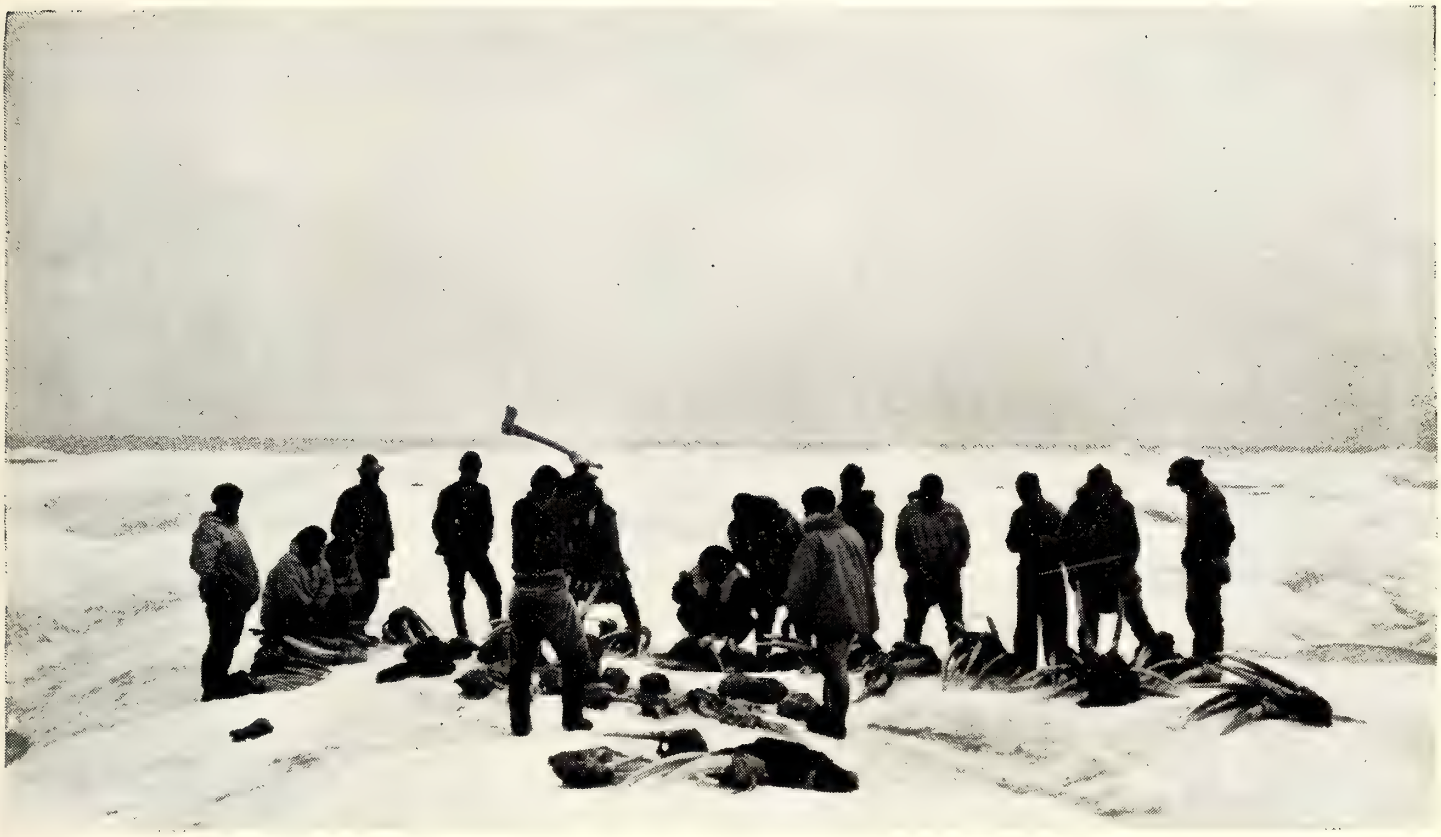
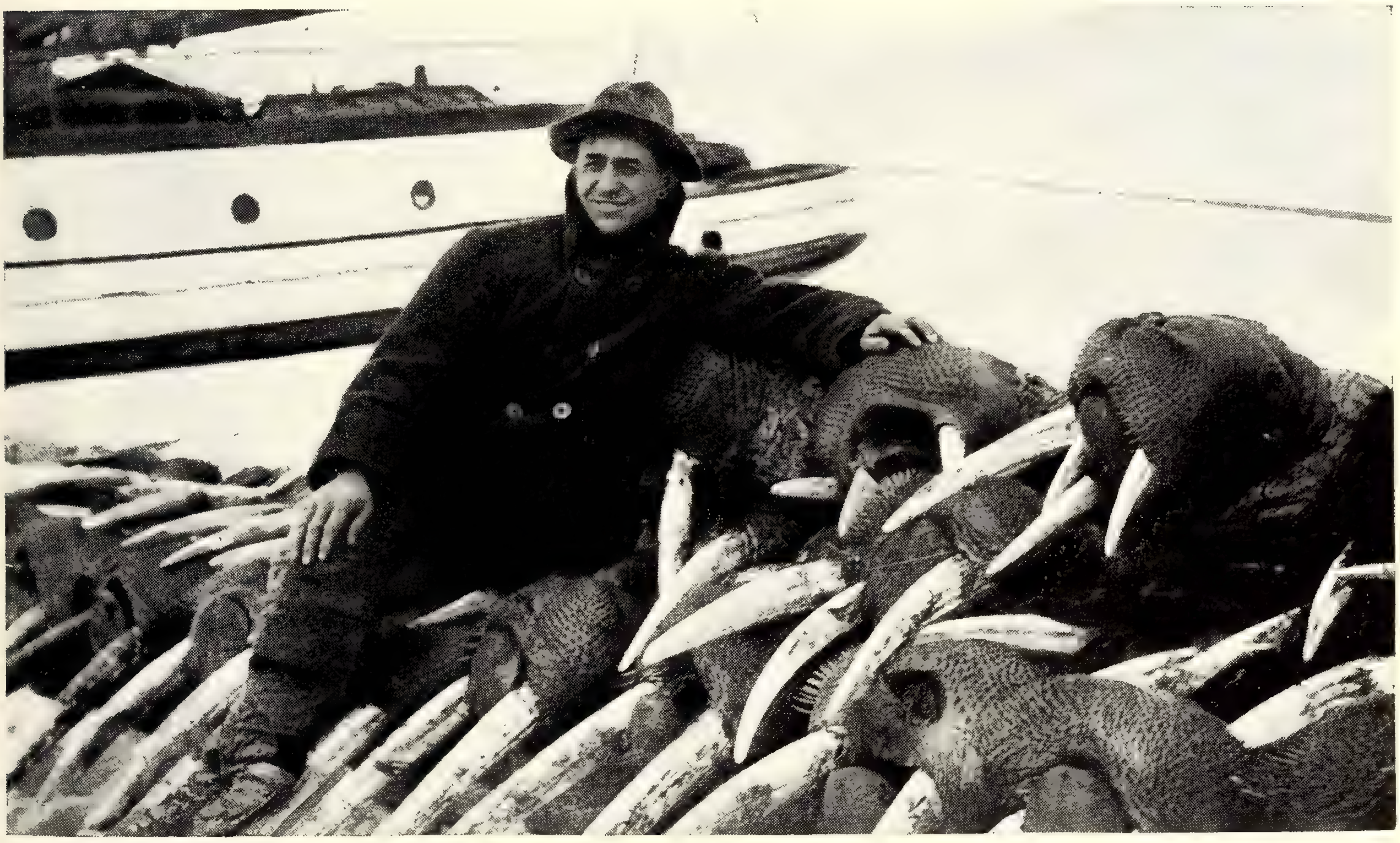


Photo by Dobbs, of Nome, Alaska

FIFTY UNUSUALLY MAGNIFICENT WALRUS HEADS

From this and the next pictures the reader will readily infer that the Pacific walrus is being very rapidly exterminated. The survivors are being driven further north each year. Such numbers of the animal as shown in these pictures had not been seen for some years, and similar herds will probably never be seen again. Fifteen years ago the number of walrus tusks from Alaska sold in San Francisco amounted to over 10,000. Now the sales are less than 100 per year. Government regulations for the protection of the walrus in Alaskan waters, promulgated in 1910, prescribe an open season for walrus hunting north of the Kuskokwim River from May 1 to July 1, and forbid all killing in Bering Sea south of that river and in Bristol Bay until 1912.



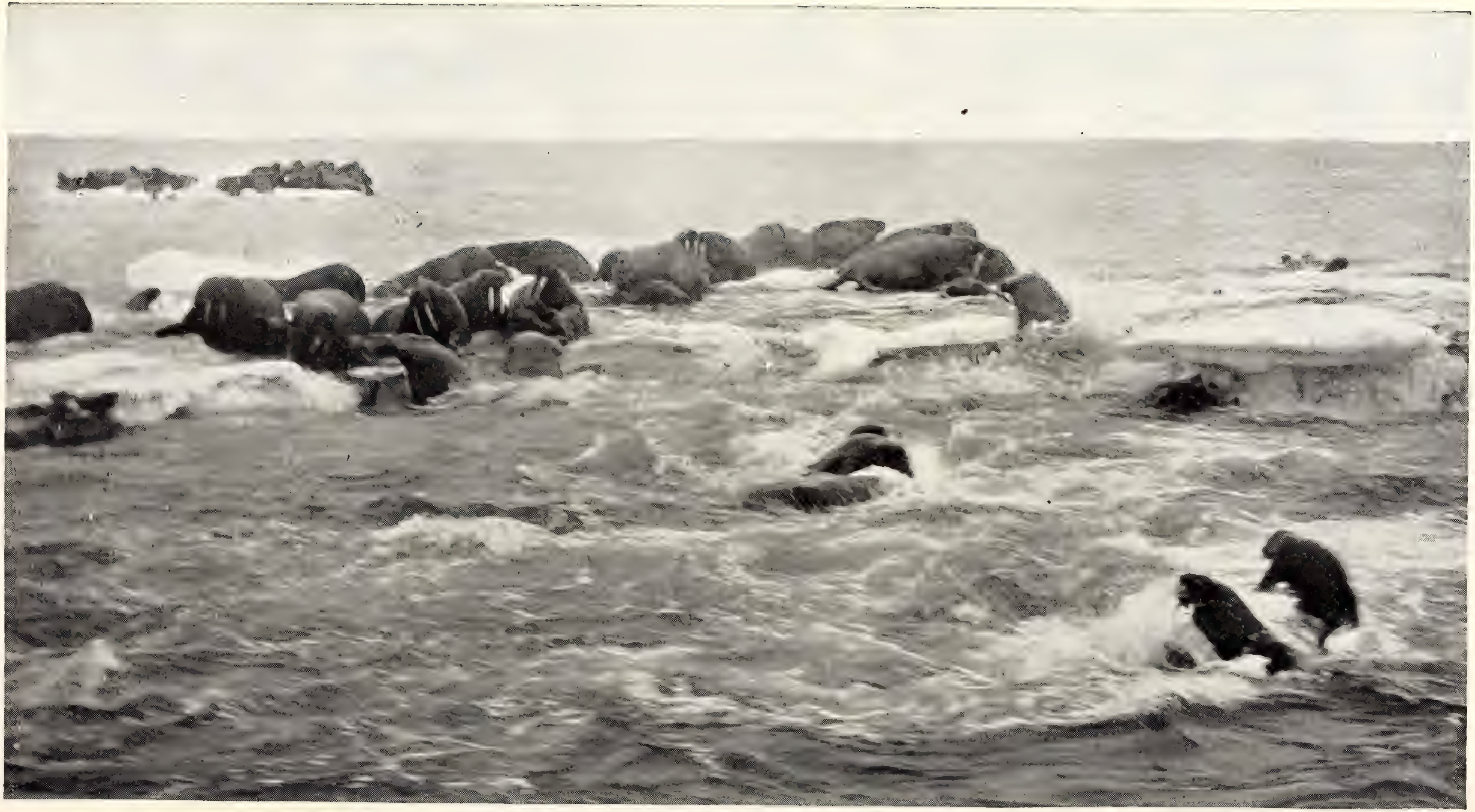


Photos by Dobbs, of Nome, Alaska

CHOPPING OFF THE WALRUS TUSKS, THE ONLY PART OF THE ANIMAL THAT IS UTILIZED BY THESE HUNTERS

The tusks are solid ivory, hard and more yellowish than those of elephants. Both males and females have tusks, but the females' are longer, their huge teeth sometimes reaching 30 inches in length. The animal uses the tusks to dig up clams from the sea bottom and to help it climb on to the ice. The ivory now sells for a dollar a pound in the open market at San Francisco.

PART OF ONE MORNING'S "BAG" OF WALRUS TUSKS



The celebrated English navigator, James Cook, who met vast herds of walrus in Bering Sea hundreds of miles south of their present limit, wrote of them as follows: "They lie in herds of many hundreds on the ice, huddling over one another like swine. (They lie just like a lot of pigs in a yard.) They roar and bray so very loud that in the night, or in foggy weather, they gave us notice of the vicinity of the ice before we could see it. We never found the whole herd asleep, some being always on the watch. These on the approach of the boat would awaken those next to them, and the alarm being thus gradually communicated, the whole herd would awake presently. But they were seldom in a hurry to get away till after they had been once fired at; then they would tumble over one another into the sea in the utmost confusion."

The Pacific walrus is considerably larger than the walrus found on the Greenland and Ellesmere Land coasts, and whose hunting is such exciting sport. See descriptions by Peary, particularly pages 79-87, in "The North Pole." Photo by Dobbs, of Nome, Alaska.

CUERNAVACA, THE SUN CHILD OF THE SIERRAS

By Russell Hastings Millward

THROUGH the many ages of travel few spots of the world have remained unchanged in the well-trodden paths of civilization; but Cuernavaca, the Sun Child of the Sierras, lies today in the little Mexican valley of the same name well preserved in its natural beauty since the time of Cuauhnahuac, when the ancient builders wrote their history in hieroglyphics.

The name Cuernavaca, meaning "horn of the cow" in Spanish, is probably a contraction of Cuauhnahuac, the more poetic Aztec term, meaning "near the mountain," and tradition tells us that it was applied by the Spanish during the days of the Conquest, in April, 1521.

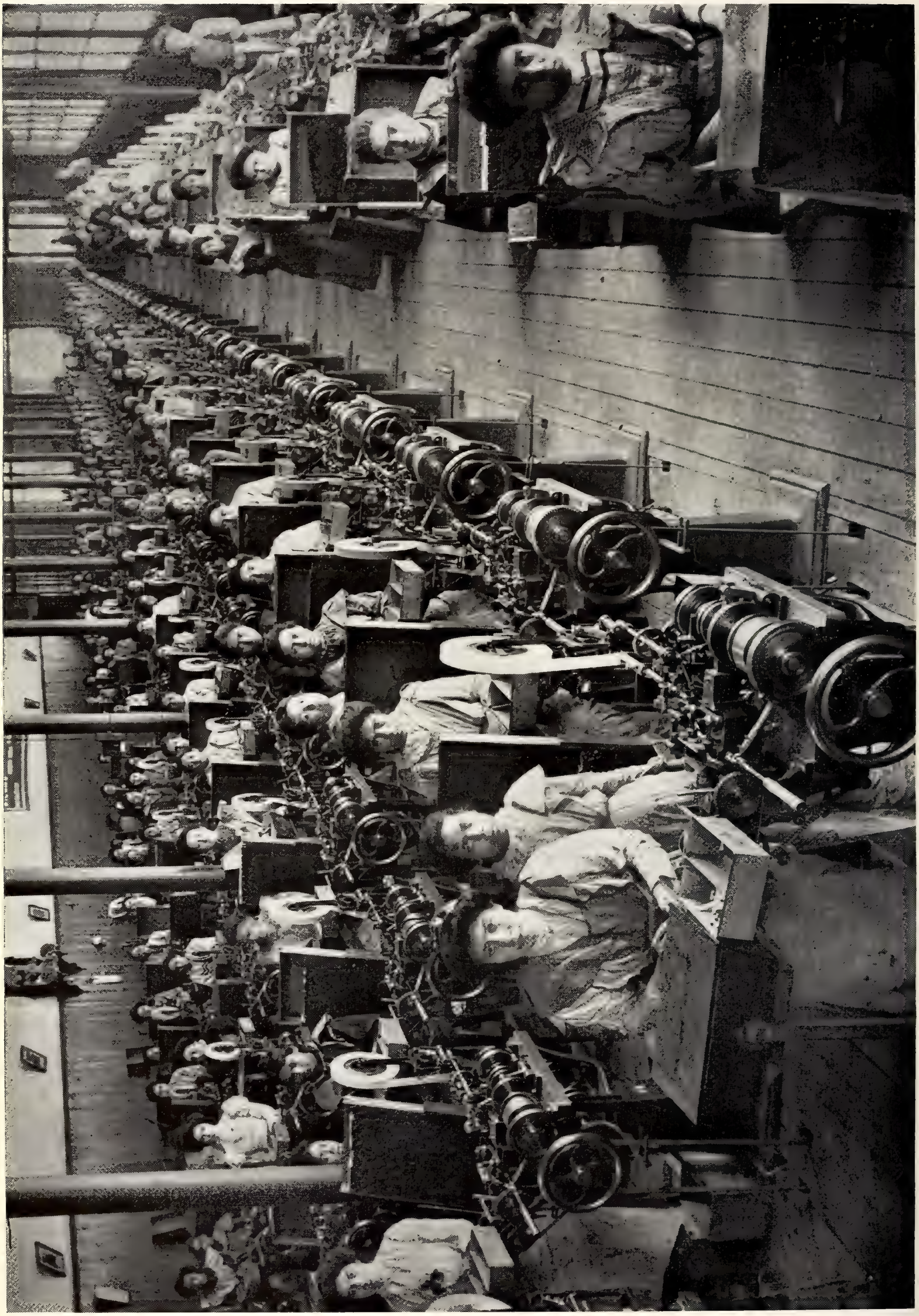
Accentuating the grandeur of the distant snow-capped mounts, Popocatepetl and Iztaccihuatl, the town is situated on the edge of the tropics, among the foothills of the Sierras. Hemmed in on every side by lofty peaks which no storm can surmount, and having an altitude of nearly 5,000 feet, which tempers the heat of a tropical sun, Cuernavaca enjoys an equable climate at all seasons of the year.

It is little wonder, then, that the Aztecs, the Montezumas, the great Conquistador, Cortez, the unfortunate Emperor Maximilian and his erstwhile Empress Carlotta sought this ideal retreat and found peace, rest, and sunshine.

There is no other 75-mile trip in the three Americas so typically Oriental and so full of charm as that from Mexico City to Cuernavaca. The four hours required to make the journey pass only too quickly, as the train winds its way through a veritable wonderland. Chapultepec, Molino del Rey, Contreras, Monte de las Cruces, and many other places of historic interest are passed, and upon reaching La Cima, the highest point on the route, at an elevation of about 10,000 feet, a magnificent view of the fertile Valley of Cuernavaca is unfolded below. Plantations of sugar-cane and coffee, fields of rice and bananas, and orchards of lemon, orange, and mango trees can be seen as far as the eye can reach.

From a line of mountains suggesting Switzerland in their sublimity and whose crests are perpetually covered with snow, the panorama extends through a country of rolling hills, winding rivers, blue lakes, tropical plains, Aztec ruins of unknown antiquity, primitive Indian villages, old mines of fabulous wealth, petrified lava streams from volcanoes of prehistoric days, and a civilization more quaint and unconventional than that found in any other part of the world.

Upon arrival at the railway station a number of rickety carriages will be found in waiting, and, after a bit of good-natured chaffing, a bargain is made with one of the "cocheros" to drive you to the village, about a mile distant. As the frail little conveyance is driven along the roadway, across the bridge, and then, swaying to and fro, over the rough cobblestones of the narrow, crooked streets of the village, you will experience a ride not soon forgotten. Vying in its excitement with a chariot race of medieval times, a contest between the cocheros is soon on in earnest. The houses of the village, which are built without a vestige of symmetry or regularity, appear to be toppling over each other as the driver frantically strives to reach the hotel ahead of his rivals. Perhaps he might be contemplating an extra tip for his cleverness, if he wins the race, for you will then be able to secure a first choice of rooms; but by what miracle has destruction of the entire outfit been averted will ever remain a mystery to you. As the fare is paid to the excited cochero you will probably declare that you will



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VIEW IN A LARGE CIGARETTE FACTORY IN MEXICO CITY

THE WATER CARRIER IN A MEXICAN VILLAGE

find some other means of returning to the railway station when ready to depart. The incident, however, will always prove a happy one in retrospect.

The town is located on a thickly wooded hill between two deep barrancas and surrounded by a number of precipitous gorges, which make it by nature almost inaccessible. Crossing these passes, however, are the Porfirio Diaz and several other notable bridges. From the Puente del Diablo (Bridge of the Devil) an excellent view can be had of one of the gorges and the two great springs, Ojos de Guadalupita (Eyes of the Little Guadalupe), which have been highly treasured by the natives for centuries. Quite near are numberless other springs and mountain streams, which have been united and form what is known as the municipal water-works. So great is the supply of water and so constant and thorough has been its distribution that the entire community has been converted into a rich grove of trees and innumerable gardens.

Nature has been most lavish in her gifts to Cuernavaca. Here time or money counts for little except the peace, comfort, and happiness it will bring. In no other place on earth is law more highly respected than in this curious little village of the red-tiled roofs, crooked streets, and cobbles.

A police force is almost unnecessary, as the natives are peaceful, happy, and law-abiding. The poor have practically no taxes to pay, as each year the city council calls a meeting of the more prominent property-owners, who subscribe voluntarily the sums necessary to maintain the public works and institutions. Each property-owner considers it a great honor to be one of the chosen, and cheerfully sets opposite his name such amount as his purse will allow. All funds are paid in and the necessary work done without delay. Truly, this is a model municipality.

Life is not a burden to any one in Cuernavaca. The natives converse in soft, musical tones and go quietly about

Photo and Copyright by Underwood & Underwood

A HAT STORE IN MEXICO

their several ways. The plazas and public markets afford agreeable meeting places and serve as an open-air social rendezvous for all classes. Military and native bands play each evening in one of the plazas, fiestas are of frequent occurrence, and the air is filled with the seductive fragrance of roses, jasmine, and orange blossoms.

Every home, however humble, has its little patio and a wealth of sunshine and flowers. The domestic life is ideal. A very pretty custom obtains on Sunday evenings and festivals, on which occasions the village maidens promenade around the plaza. They usually take the inside turn, strolling in one direction, while the "novios," or village beaux, take the outside turn, in an opposite direction, and in this manner face each other at all times. It is not customary for a Mexican maiden to go about unless attended by some member of her family, and it is most amusing to witness the small brother, when pressed into service as an unwilling escort, trudging along hand in hand with his laughing, bright-eyed sister.

The Cortez Palace, built in 1531, where the patriot Morelos was confined as a prisoner of war, and which is now used as the capitol of the State of Morelos; and the Cathedral, built in 1535, whose tower contains a clock from the Cathedral of Segovia, bear silent testimony to the noble and quiet manner in which Hernando Cortez spent his life after the Conquest. He made Cuernavaca his residence and personally managed the vast estates in the vicinity which had been granted to him by Charles V of Spain. One of these estates, the Hacienda de Atlacomulco, is still intact and contains a sugar plantation and refinery under active operation.

During the second empire Maximilian and his consort, Carlotta, made Cuernavaca the summer capital of their court, and spent the few tranquil and happy days of a stormy career at their country residence, Olindo, in the suburbs of the town. They also paid frequent visits to the Borda gardens.

These gardens of world-wide fame were laid out by Don José de la Borda in 1762 with the idea of reproducing, on a grander scale, the gardens of Versailles. In order faithfully to carry out his plans, he sent to France for landscape gardeners and expended over a million dollars in the work. The natural springs on the estate were transformed into lakelets, cascades, and luxurious baths. Sloping terraces, bowers and trellises of roses, groves of laurel and mango, costly fountains and vases, casinos and pavilions, formed part of the adornment. Birds of gorgeous plumage made their nests and sang in the trees that shaded the fern-lined walks. Plants and flowers of the rarest varieties were brought from all parts of the world and arranged with the most artistic skill, and it has been aptly said that even today the place lacks but an apple tree to convince the visitor that it might have been the original Garden of Eden.

Don José was extravagant with the millions dug from his rich mines, the great "Asturiana" at Zacatecas, the Tlalpujahua, and the Tasco. During his lifetime he performed many acts of charity and gave generously to the arts and sciences. Many of his institutions have survived him, and the shrine at Tasco, which he built of virgin silver, has been classed among the most sacred of Mexico.

The Morelos baths, with their gardens of roses and tropical plants, owned by the governor of the State, remind the traveler of a bit of Granada. Then there are the gardens of the Bishop's palace, which faithfully typify a courtyard of the middle ages.

Like Boston, the streets of the town appear to have been laid out by the cows. The Calle Nacional, the principal street, with its quaint shops, offers many attractions to the lover of antiquities. There are also a number of interesting public buildings, including the palace of the governor, the Porfirio Diaz Theater—which also contains the public library—the literary institute, the post and telegraph offices, the barracks, and a number of public schools, hospitals, and charitable institutions.

It appears to matter little whether buildings are old or new in Cuernavaca. They have all taken on the mellow coloring of antiquity and harmonize with surrounding nature.

The town is unique in another respect: it is the home of Isabel Belaunsaran, maker of the smallest dolls in the world. She is called "Queen of the Needle" and is most affectionately regarded by all the natives of the village. They will tell you that no cleverer Mexican Indian maiden has ever been known, and that she has restored a certain style of needlework long supposed to have been lost. Besides the more serious work of

THE PUBLIC LETTER-WRITER IN A MEXICAN VILLAGE

Two-thirds of the 15,000,000 inhabitants of Mexico can neither read nor write

embroidering a number of costly and pretentious pieces, Isabel makes these diminutive dolls, which in both point of construction and design are the most remarkable in the world.

The operation of making consists in forming a tiny framework of wire barely three-fourths of an inch in length and winding the same with many turns of silk thread. After the frame has been properly formed it is ready for dressing. The clothing is cut according to the character of the doll and fitted carefully about the small figure. The most difficult work, that of embroidering, is then begun. With a needle that can scarcely be held in the fingers and the finest of silk threads, various designs are actually embroidered on the clothing, and so cleverly is the work executed that even through a powerful magnifying glass the details of the design appear to be perfect.

After dressing the figures it is necessary to add the hair, and what is undoubtedly an example of the tiniest and most marvelous hair-dressing known is then performed on each doll. Even to the details of the braids and ribbons, the work is completely carried out. The eyes, nose, mouth, hands, and feet are then formed and the doll is ready to be placed on sale in the village shop.

On account of their daintiness, exquisite coloring, design, and workmanship, these dolls find at all times a ready sale at the ridiculously low price of 25 cents each. But two hours are required to make each doll, so it can readily be imagined just how rapidly the work must be done, although the finished prod-

Photo and Copyright by Underwood & Underwood

GATHERING THE LUSCIOUS FRUIT OF A HEAVILY LADEN MANGO TREE: CUERNAVACA

ISABEL BELAUNSARAN

Maker of the smallest dolls in the world. She holds a tiny doll in her left hand (see page 295).

uct shows no signs other than those of artistic skill and extreme patience. By working steadily for 10 hours the sum of $1.25 may be earned—less than that paid for the same period of time to an ordinary day laborer in the United States for work of the crudest kind. So constantly has this little maiden used her eyes that she is beginning to lose her eyesight.

The dancing-girl dolls are particularly attractive. Miniature roses are embroidered on their dresses and hung about the shoulders. Ornaments are arranged in the hair and the tiny limbs are formed in graceful and lifelike attitudes of dancing.

The costume of the matador doll is gaily embroidered in colors and its hair dressed in Spanish style, including the conventional cue. Slippers are added, a sword and muleta are placed in the hands, and the manikin bull-fighter is ready to enter the ring, so far as miniature details of dress and equipment are concerned.

The flower-girl dolls are dressed according to the custom and provided with small baskets woven of fine hair filled with flowers of variegated colors. The hair is arranged in a double braid, and artistic shawls, brilliantly colored, are hung loosely about the shoulders. The tiny flower-sellers are then not unlike those seen in the flower markets throughout Mexico.

Vaqueros are represented in their most attractive and picturesque attire. Faithful reproductions of the native serapes are thrown about the shoulders, and sombreros, woven of fine hair, are placed on the heads in true Mexican fashion.

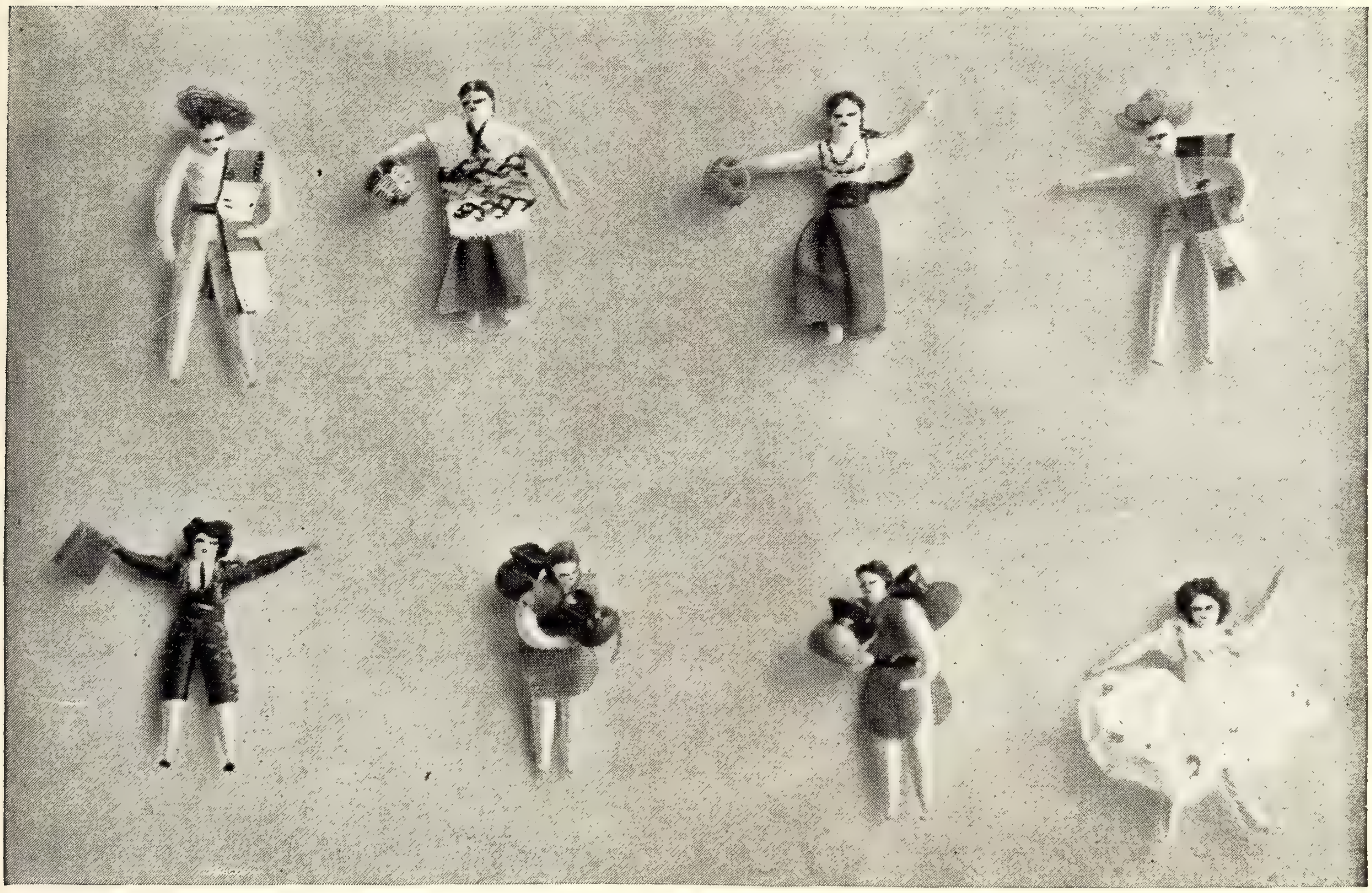
Aguadors are provided with tiny ollas, made from clay and fashioned on the exact lines and proportions of the practical sizes, and are considered important members of the doll family.

Religious dignitaries are also represented in this remarkable doll family and are dressed in full accordance with the character which they are supposed to represent in dignified miniature.

It is difficult to believe that human hands could have fashioned such wonderful little figures. A photograph cannot do justice to the coloring and execution, and it is only after they have been examined carefully through a magnifying glass that they can be fully appreciated.

The first dolls of this kind made by Isabel were secured by several of the royal families. They were also included in many private collections, where they are always greatly admired.

A German traveler criticized the dolls one day and told the little Indian maiden that in Germany they had fleas fully dressed and trained to perform the most wonderful feats. "Yes," answered she, "I remember my father telling how those trained fleas were first sent to your country from Mexico. We cannot dress the fleas so completely as the dolls, however, as we cannot make them stand still long enough. I suppose," she added, naïvely,



THE DOLLS OF CUERNAVACA, ENLARGED SLIGHTLY IN THE PICTURE
(SEE PAGES 296-298)

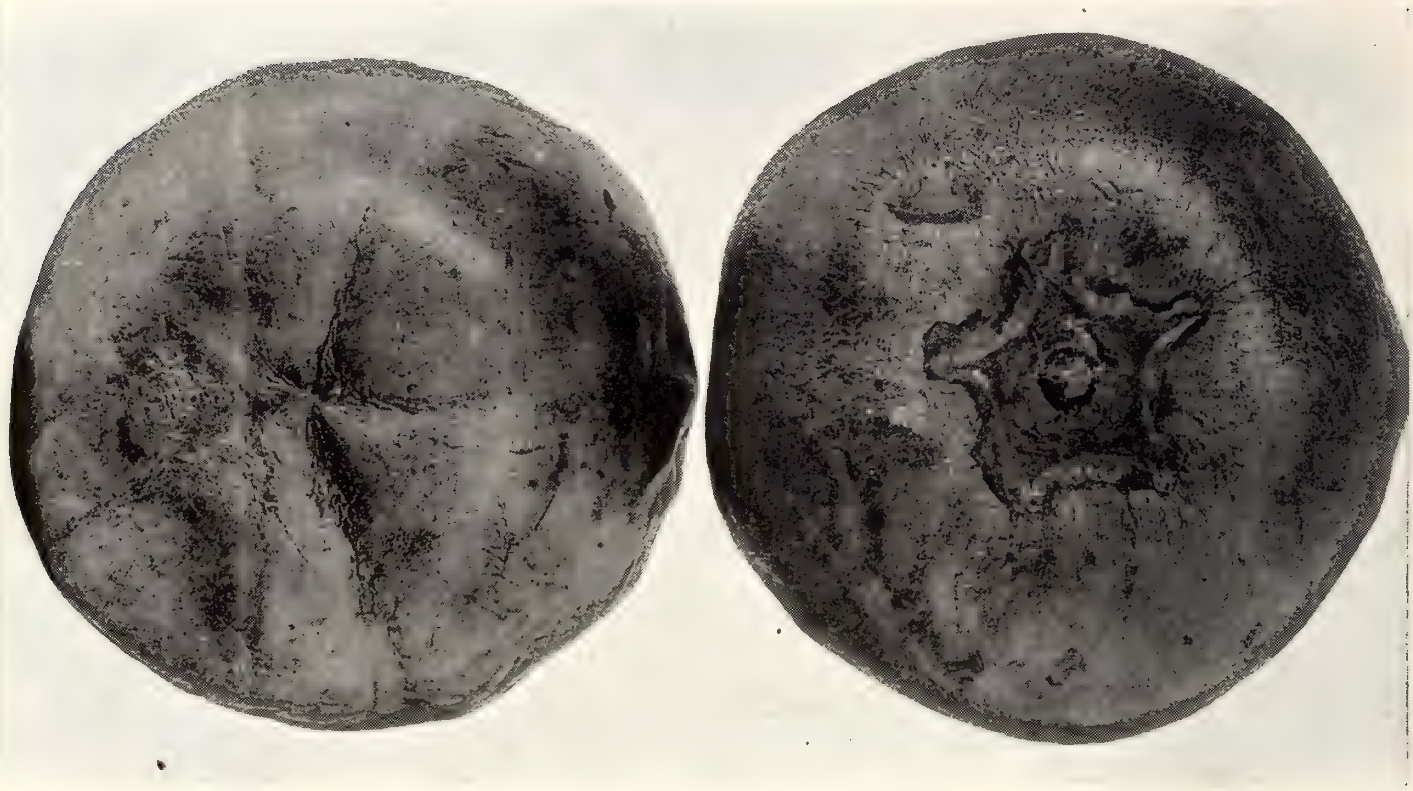
"you can make fleas stand still as long as you like in Germany."

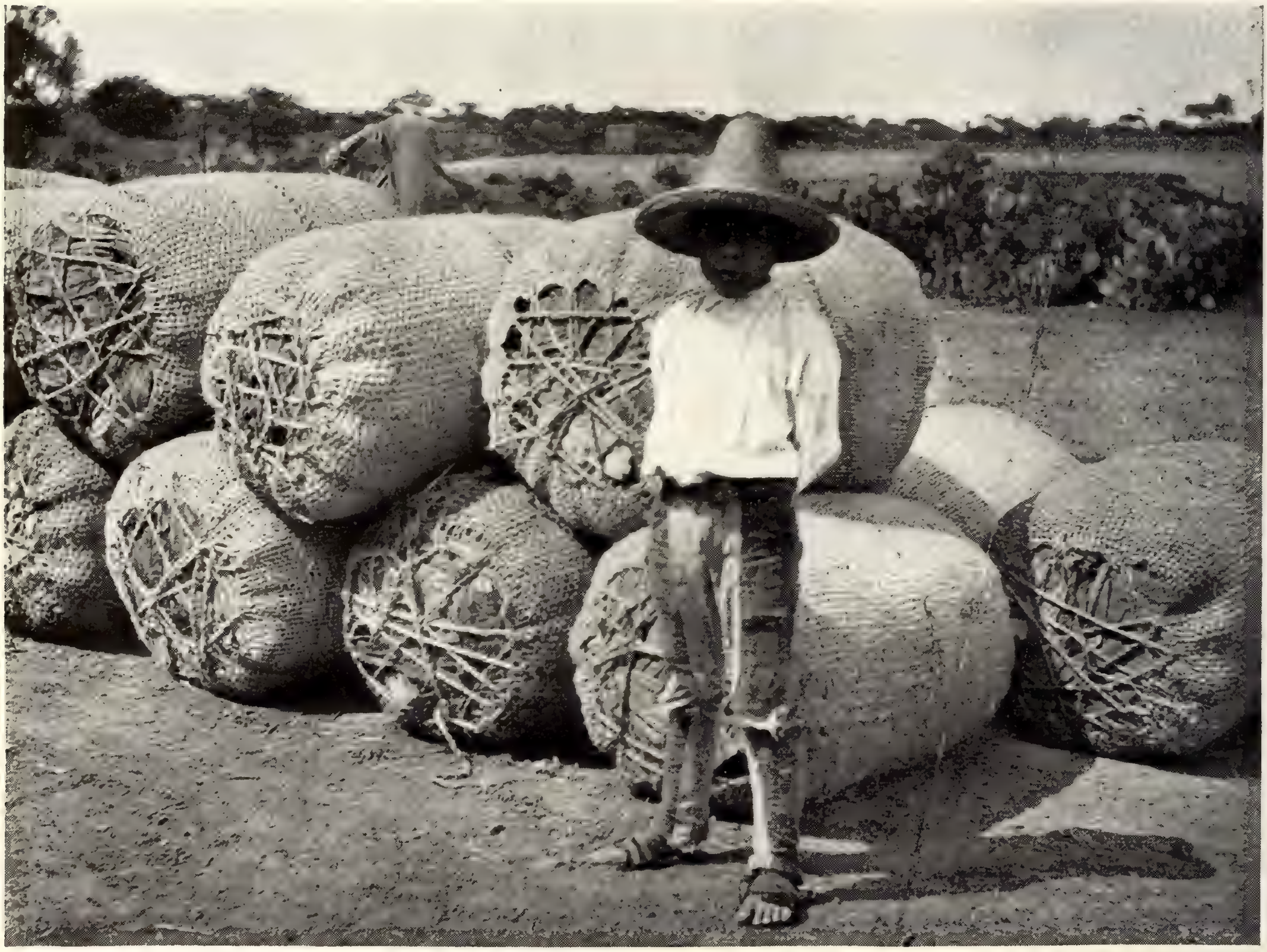
In the vicinity of Cuernavaca the country abounds with places of geographic and scientific interest. The haciendas Acapancingo and Temisco, over two centuries old, and the Buena Vista, where sugar-cane rum is distilled, are well worth a visit. Just across the barranca to the west is a lake of great beauty and the Falls of Saint Anthony, noted for its resemblance to a long white feather. Near by is the village of San Anton, where stand several buildings of unknown antiquity and an old house built by Cortez in 1521, all in an excellent state of preservation.

Time has not been able to efface primitive methods in this locality, and Indian pottery, known as "La Verita," is still being made here by Lupe, "King of the Pottery Makers," in much the same fashion of his forefathers. This pottery is made in a great variety of distinctive shapes, is rich maroon in color, and rude, almost classic, in design.

Many prehistoric stone carvings are found in the neighborhood of Cuernavaca. The Lizard Stone, measuring nearly 9 feet in length; the Stone Eagle, measuring about 10 feet across its extended wings, and the Victory Stone, with its curious carvings of a shield, five spears, and a tomahawk, evidently marking an ancient victory, are particularly interesting.

Other evidences of an ancient civilization are found at Amanalco, Tlaltenango, Tlalmanalco, the Hill of Quauhtetl, the Ruins of Tepozteco, Xochiltepec, and in the caves of the Amates, "The Grotto of the Devil," where steps were cut from the solid rock on the occasion of a visit by Empress Carlotta. On the summit of a small ridge west of Cuernavaca are the Ruins of Xochicalo and the remains of a prehistoric city. Among these ruins is a pyramid, fort, or temple, which is built of cut porphyry and measures 68 by 75 feet. Its walls are filled with carvings of birds, animals, and warriors, which are more curious and interesting than





Photos from G. N. Collins and C. B. Doyle, Dep't of Agriculture

A POPULAR MEXICAN FRUIT, THE "SAPOTE PRIETO" (*Diosoyros ebenaster*)

It is seedless, its flesh of a very dark-brown color, and closely related to our common persimmon (see page 301)

CHILES (MEXICAN PEPPERS) READY FOR SHIPPING anything of a similar character yet found in Egypt.

About seven miles from Cuernavaca is the Indian village of Juitepec, where some of their mysterious customs are still observed. The place has the appearance of a stage setting and the natives of the village are like the characters in a play. Each year a strange feast is celebrated in an ancient church and pilgrimages are made to its shrine by natives from a number of the outlying districts.

How these people have preserved their ancient customs through such long periods of time is unexplained. They seem to be in a world by themselves and care little about the outside. The traveler will not regret a visit to these remarkable places, which are all within such convenient distance of Cuernavaca.

Altogether Cuernavaca quite fascinates with its mysterious charm and idyllic picturesqueness. Glorying in its atmosphere of legend and romance, free from care, free from the struggles and vicissitudes of a modern world, surrounded by forbidding mountains, which seem to keep eternal vigilance over it, this little pastoral community, the Sun Child of the Sierras, peacefully slumbers and dreams on.

NOTES ON SOUTHERN MEXICO

By G. N. Collins and C. B. Doyle, of the U. S. Department of Agriculture

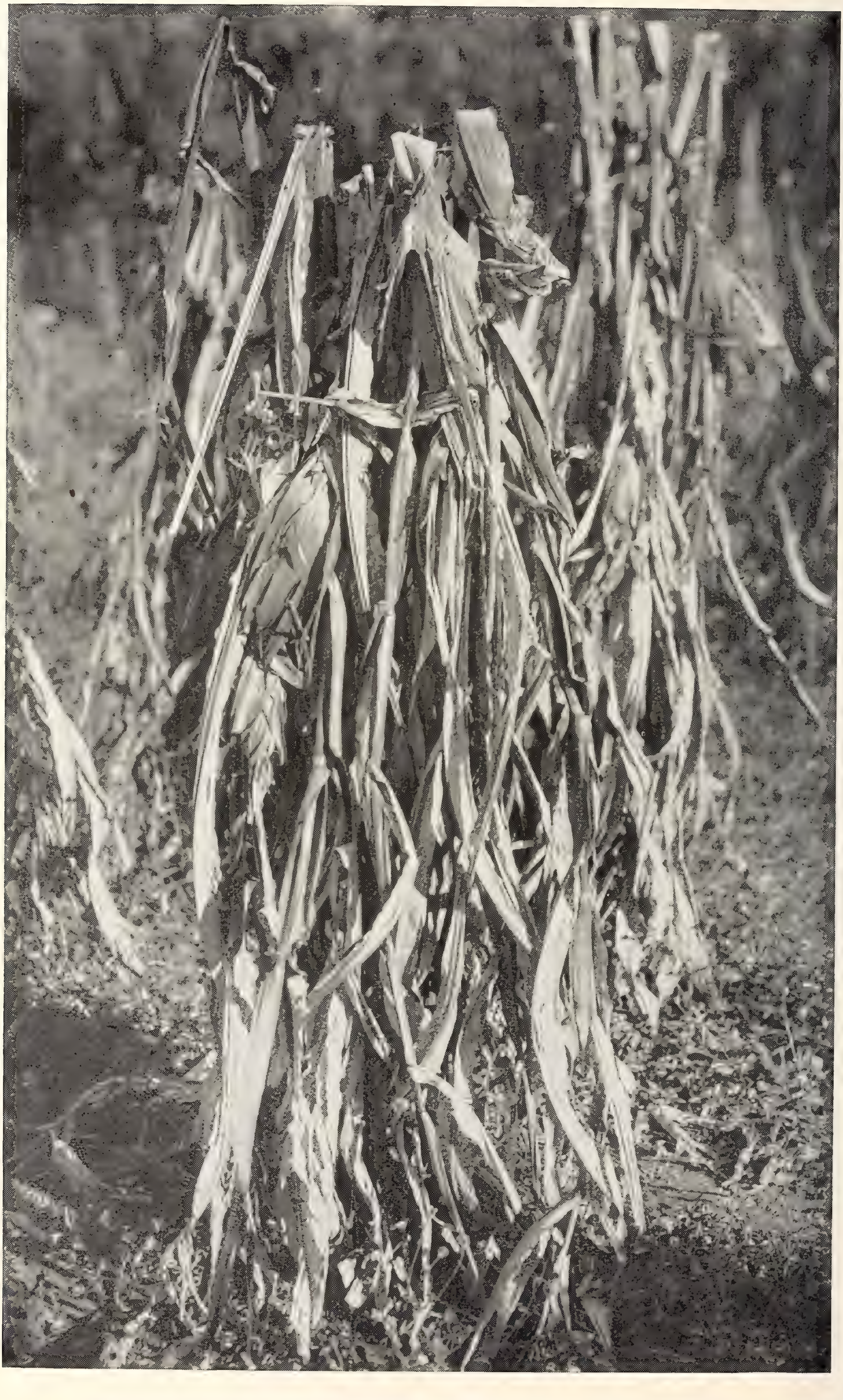
With Photographs by the Authors

THE chief object of our expedition to southern Mexico was to investigate the cotton culture of that region. It had been learned that there was a cotton mill at Providencia, Chiapas, and that part of the cotton used in the factory was grown locally. As the cotton-boll weevil was known to exist in this region, it became of interest to discover, if possible, why this insect did not prohibit the commercial culture of cotton here as elsewhere in the American tropics. It was further planned to cross Chiapas and visit some of the rubber plantations in Tabasco, where the oldest plantations of Central American rubber are known to exist.

During our stay in Mexico City we made a rather careful study of the markets. There was a comparatively poor display of fruits and vegetables at the time (November), much less than we saw there on our former visit. The most common fruits were bananas, oranges, pineapples, guavas, figs, pawpaws, apples, mamee sapotes, and strawberries. The strawberries were of good size and flavor and remain white when perfectly ripe.

Another fruit very common in the market at this time of the year is the "sapote prieto" (*Diospyros ebenaster*). This fruit was entirely new to us. The flesh is stringy and very dark brown, almost black. It is very unattractive in appearance and the taste is rather insipid, but the fruit is very popular with all classes, fair specimens selling at 5 cents, Mexican, apiece. Many specimens are entirely seedless, suggesting that the species has been cultivated from remote periods and probably by asexual methods. This fruit was afterwards seen growing at Cuernavaca. The trees were 40 or 50 feet high and about one foot in diameter. As this species is closely related to our common persimmon and the fine Japanese forms, it may be of interest to form hybrids of these fruits.

On December 4 we left Mexico City for south Mexico by way of Cordoba and the Vera Cruz and Pacific Railroad. Corn is quite extensively cultivated about



"DOUBLED" CORN: CHIAPAS, MEXICO (SEE PAGE 301)

Cordoba, and here, as in all parts of this country where there is insufficient pasture, the tops of the stalks are cut off for fodder as soon as the corn is full grown. At the same time the stalks are also broken down just below the lowest ear, so that the ears hang with the tips down, a process known as "doubling."

This custom of "doubling" was afterward found to be universal throughout southern Mexico, both in dry and wet regions. In dry localities it is employed to protect the grain from weevils. The corn is left in the fields often for months and, except in rare cases, is there immune from the weevils. In the moist regions this practice allows the grain to harden without injury from the rain, as the ears shed water perfectly when hanging. Doubling might be used to advantage in parts of the United States when there is excessive rain at the time of harvesting, such as the summer of 1906 in the vicinity of Washington, where quantities of corn were ruined through the germination of the grains before the corn was picked.

Another important reason for this practice in some parts of Mexico is to protect the ears from parrots and parroquites. While the ears are erect the birds can light on the side of the ear and open the husks, but when the ear is pendant they have no place to stand from which the tip of the ear can be reached.

Santa Lucrecia, which is situated at the junction of the Vera Cruz and Pacific Railroad with the Tehuantepec Railroad, is the region of greatest activity for rubber stock companies. About here and for some distance south there is little or no virgin forest, but the land is covered with a luxuriant second growth. Numerous rubber trees can be seen from the railway, but they are all small. The leaves, however, are fresh and green.

From Santa Lucrecia south the railroad gradually ascends. Before reaching the summit of the divide the country becomes broken and is covered with fine large forests. North of Rincon Antonio the land is open and rolling, cattle abound, and the dry-land type of vegetation appears.

From a botanical standpoint Rincon Antonio would be a very interesting place to spend one or two weeks. It is pleasantly situated and has what looks like a clean hotel. The climate is dry and not very hot. Trips could be made north into the fine dense forests, which are as wild and tropical as anything on the Isthmus. To the south it is but a little way to cactus forests, through exceedingly rough and interesting country. This region is sparsely inhabited and the settlement is completely isolated. A study of the agriculture of these people would probably show plants with interesting adaptations to drought and short season.

We reached San Geronimo on the evening of December 8. The inhabitants are chiefly Indians, though there are a number of Mexicans and Americans living there who are connected with the Pan-American Railroad, of which this town is the western terminus.

The country about is perfectly flat, with hills visible in the distance in all directions. The type of vegetation is decidedly desertic, the strong winds which blow for the greater part of the time doubtless aiding in accentuating this feature.

The change from the continual climbing and striving to reach the light that is so apparent in the forests a few miles north is very striking. Not that the plants here shun the light, for the typical shape is spreading—a form that secures the greatest isolation—but it is as though there was an effort on the part of each species to get as close to the ground as possible. The advantage gained by shading the roots and resisting the wind is obvious.

Another characteristic that is quite general is the tendency to have finely divided leaves, though the reason for this is by no means so clear and would seem to counteract the shading of the roots, for the leaflets close during the middle of the day, when the sun is brightest. The possession of these characteristics causes a number of only distantly related plants to present an almost uniform appearance. Thus what appeared to be a single species forming a low tree with spreading top

BEANS PACKED IN A COW-HIDE TO PROTECT THEM FROM GRAIN WEEVILS (SEE PAGE 309)

and pinnate leaves proved to consist of five different species belonging to at least three genera and two families.

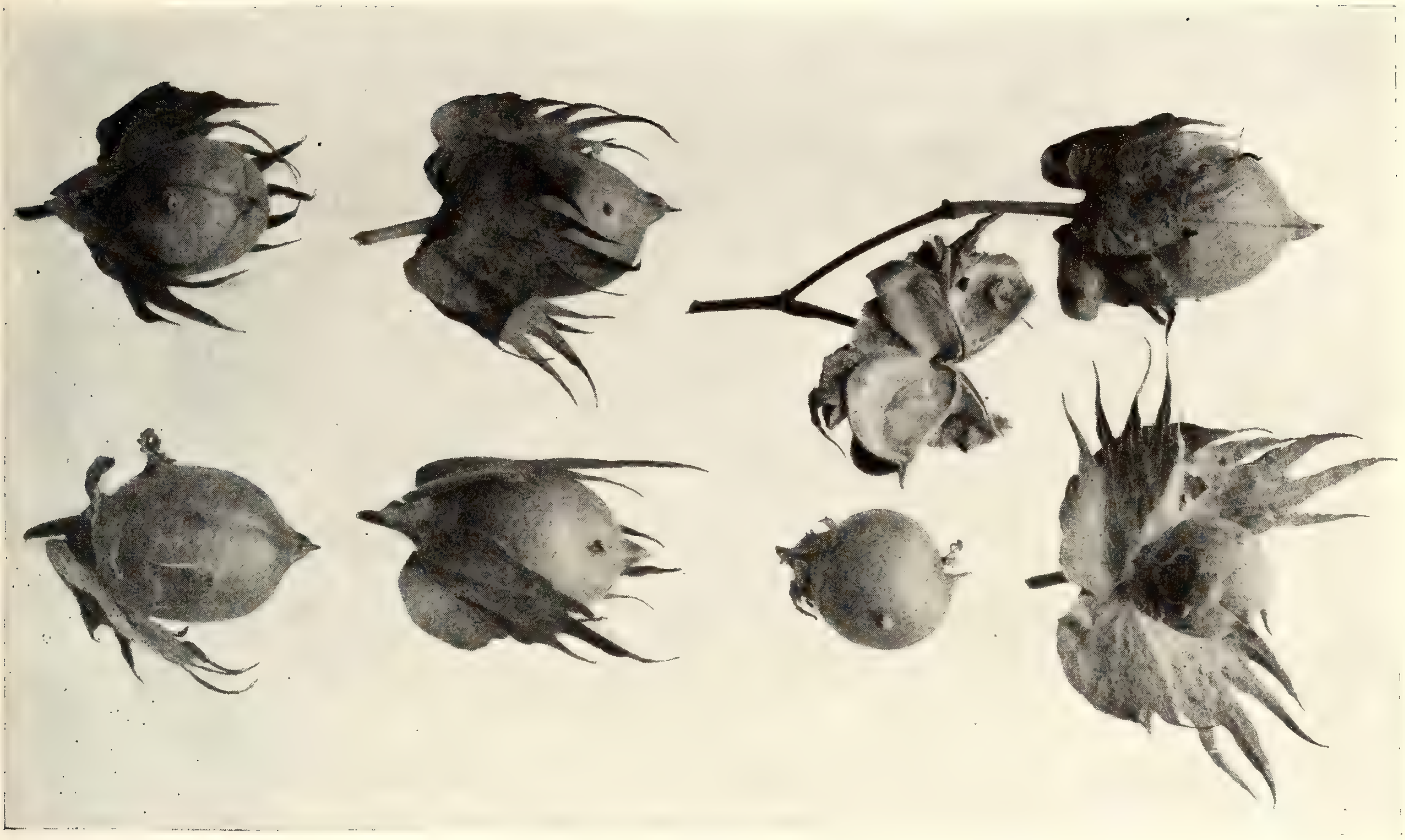
We found that the cotton mill at Providencia is not located on the shortest road between Jalisco (where we left the railway) and Tuxtla, so that our baggage was sent direct to the latter place by ox-cart, while we with two pack animals took the old road which passes through Providencia (see map, p. 316).

The rise from Jalisco is very abrupt. In one or two hours we had entirely left the lowland type of vegetation, and oaks and pines put in an appearance. Before night we had left the oaks, the only trees being pines. We spent the first night at Los Pinos, where we secured several varieties of corn. Los Pinos is at an elevation of about 2,600 feet, and although we found very much higher country farther north we had already crossed the continental divide, which is here close to the Pacific coast.

The next morning we reached the cotton mill at Providencia. This mill, though small, is very complete, much of the cotton being received as seed cotton. About 150 pieces of cotton cloth, each 82½ feet long, are turned out daily. The entire output is sold locally—that is, in Chiapas—this being the only cotton mill in the State. The bulk of the cotton used in this mill is imported from the United States and from Mexico through the port of Acapulco. The local supply averages about 5 tons yearly, but it is the best grade of cotton that they secure.

We were treated with extreme courtesy by the manager of the mill and secured a quantity of cotton seed from the picking of Acala and San Bartolomé, the centers where most of the cotton in this region is grown. Although at an elevation of over 1,000 feet, sugar-cane is successfully cultivated here, the factory turning out both brown sugar and rum for local consumption.

Beyond Santa Lucia the country is very barren. There are long level stretches surrounded by high pinnacles of rock



BOLLS OF "CULLUCHE" COTTON (SLIGHTLY REDUCED)

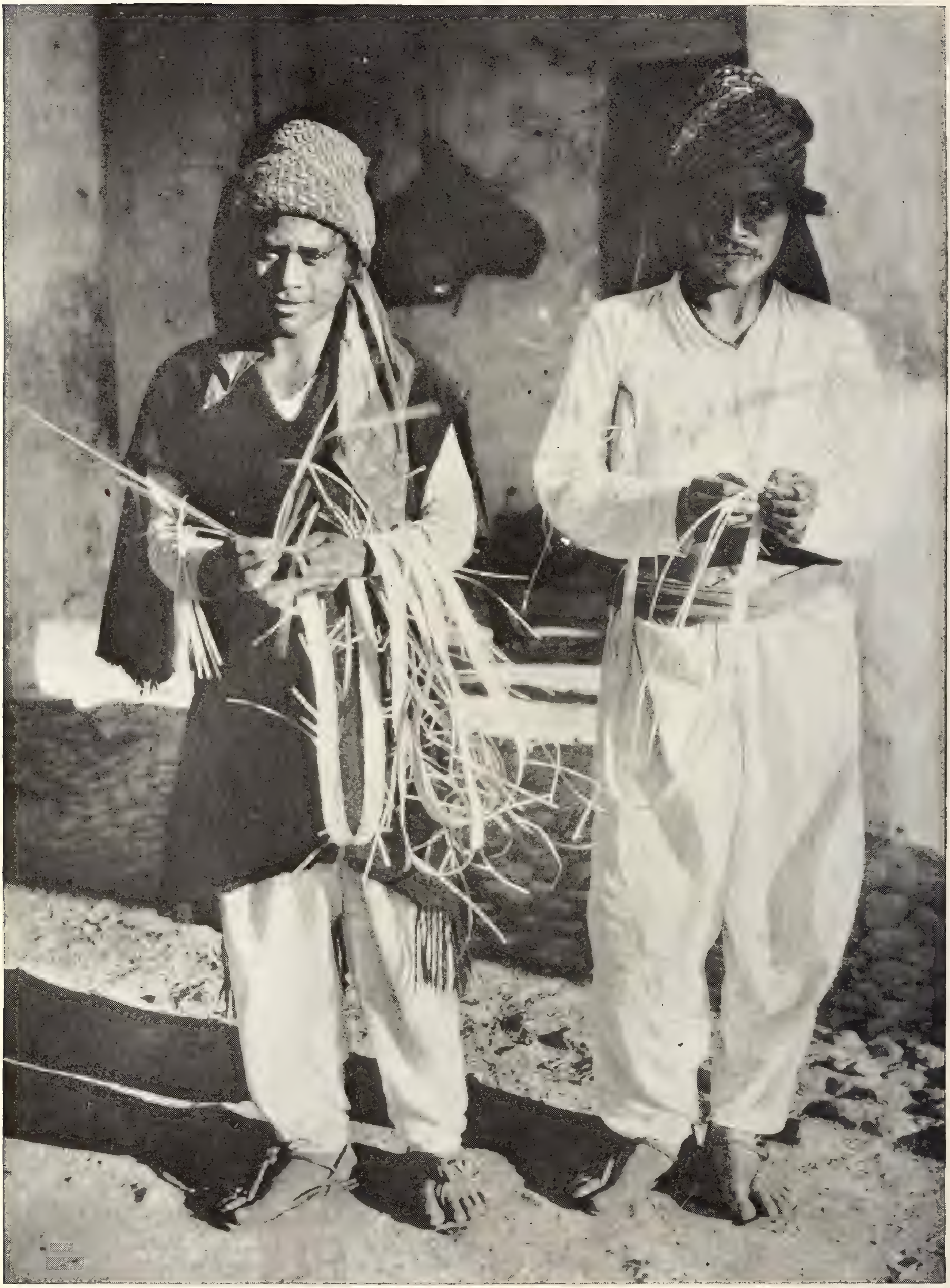
This cotton protects itself against the boll weevil in most vigorous fashion. As soon as a weevil has deposited an egg inside the cotton boll, the plant manufactures tissue around the egg and smothers it. The buds are protected by a small jumping spider, which weaves a web across the base of the bracts (see pages 310 and 313).

which appear to be limestone. Here logwood is abundant. So far as we could learn, no use is made of this dyewood, and the transportation facilities are probably insufficient to warrant its exportation. The only agricultural operations seen in this part of the country were a few scattered fields of Indian corn and young henequen plantations.

Traveling in this sparsely inhabited region, one always fares well at the haciendas along the road, but in the towns it is difficult to secure any accommodations. There is not sufficient travel to warrant hotels, and the generous hospitality of the *finqueros* is entirely wanting in the towns.

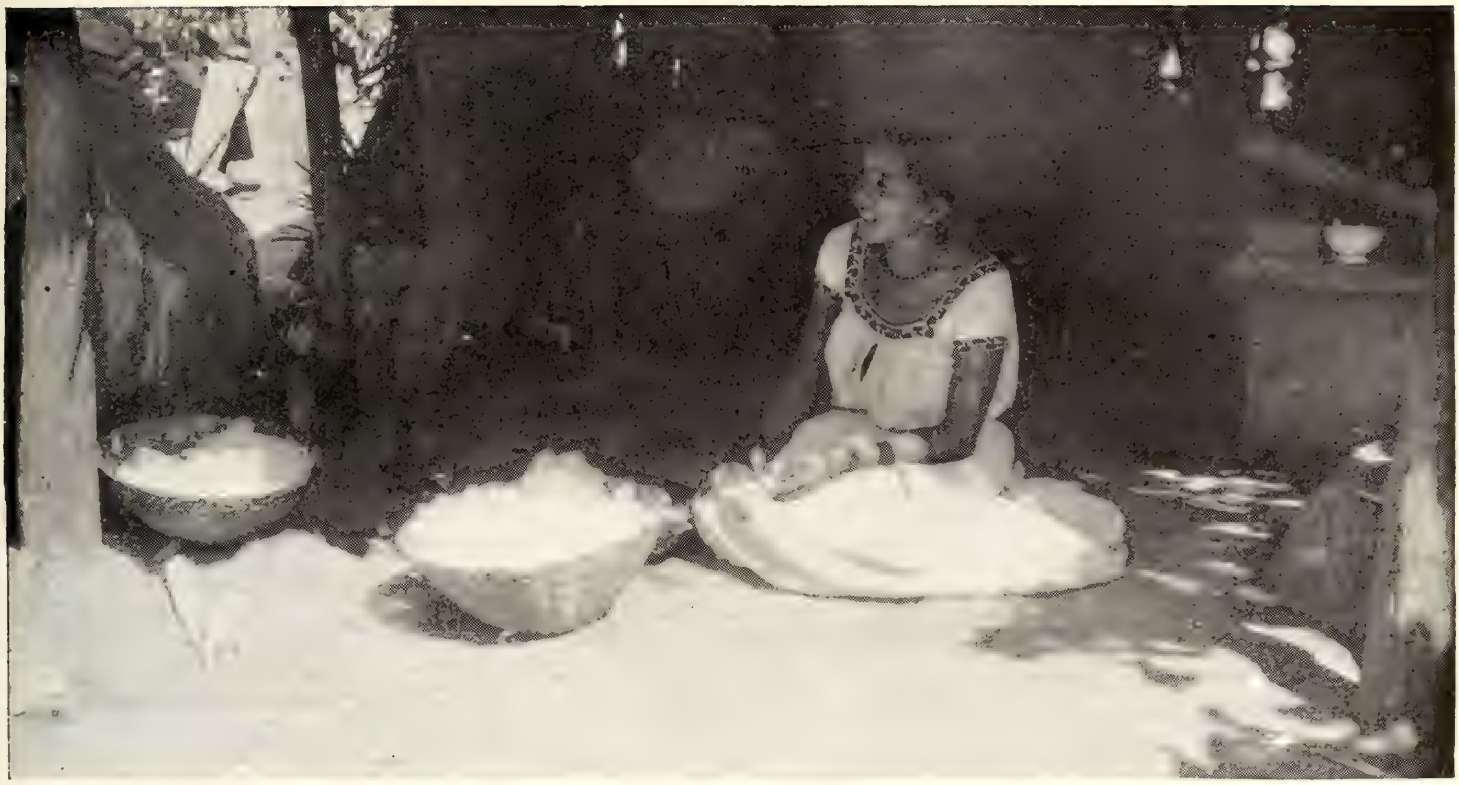
At Cintalapa we learned of a cotton plantation at Rosario which we visited. The way from Cintalapa to Rosario leads through two broad valleys separated by low hills; the same dry-land type of vegetation continued, consisting of fine-leaved legumes, grass, and occasional cacti. Occasional corn fields were the only signs of cultivation. The corn had all been harvested, and the plants showed that they had been doubled and the tops cut for fodder. At Rosario, which is located on similar land, Señor Tirado is growing beans, corn, tobacco, cotton, sugar (with irrigation), and henequen. He also keeps a quantity of cattle and is making cheese. The place is a striking example of what can be done on these dry lands by intelligent management. Señor Tirado gladly gave all information requested and is willing to send seeds to the Department or aid in any way possible.

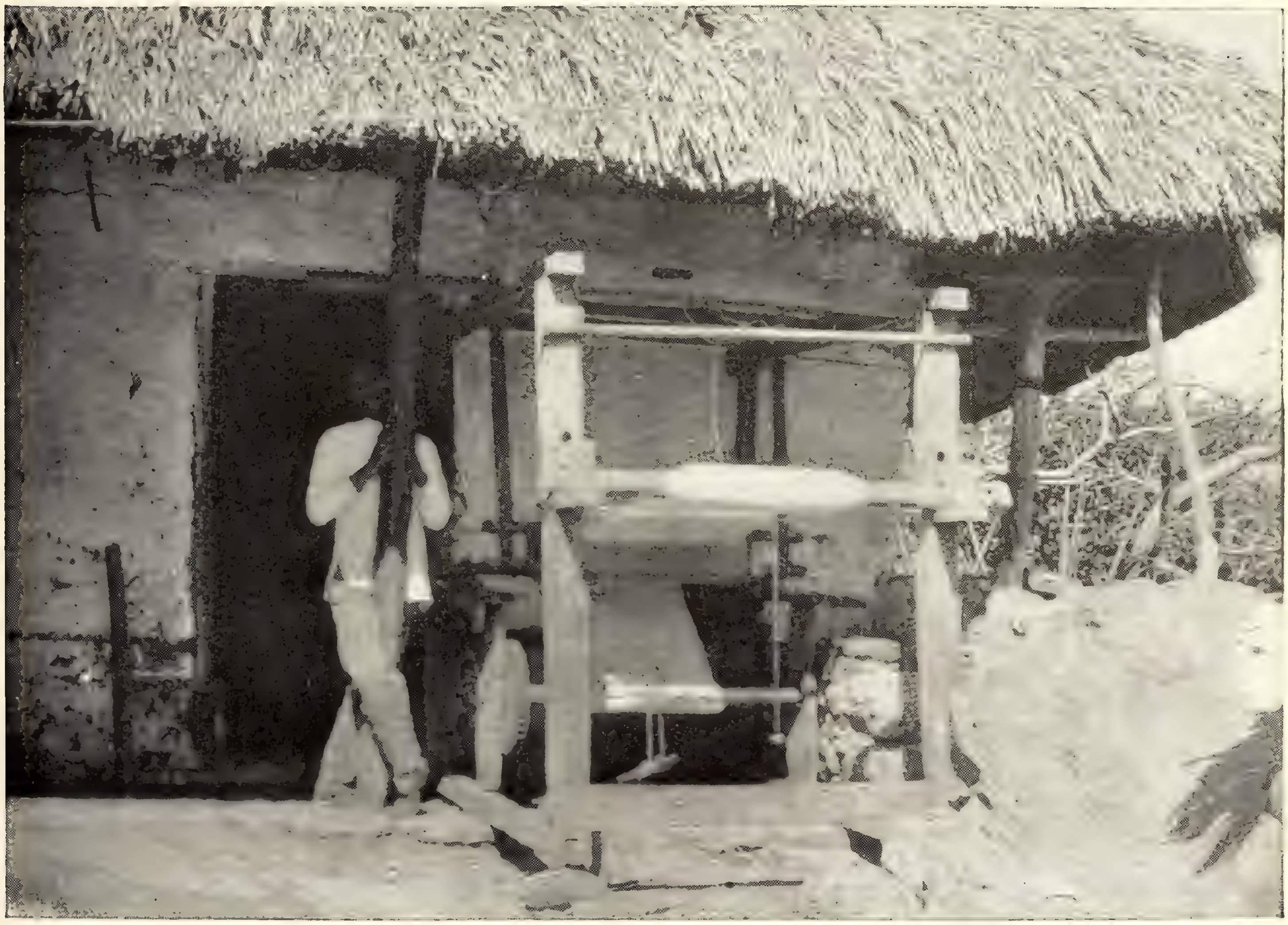
The cotton crop at Rosario had just been harvested, but the plants had not been destroyed, so that we were able to secure data regarding the nature of the variety and its method of culture. The field used this year for cotton was about 20 acres of practically level, sandy ground inclosed by low hills.



INDIANS WEAVING MATS FROM INODES FIBER: SAN BARTOLOMÉ

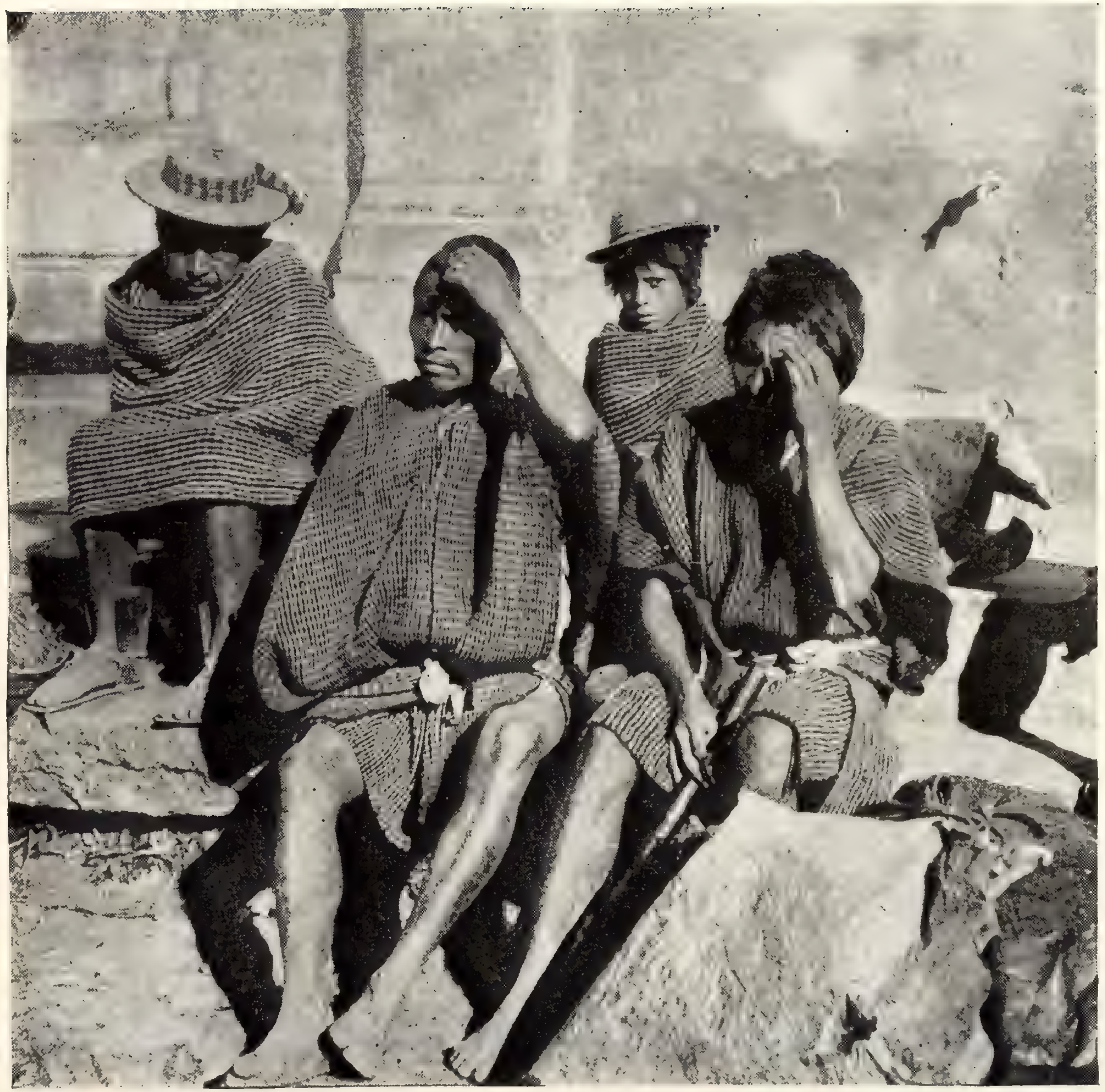
The men wear a red cloth, tied like a turban, around the head (see page 315)



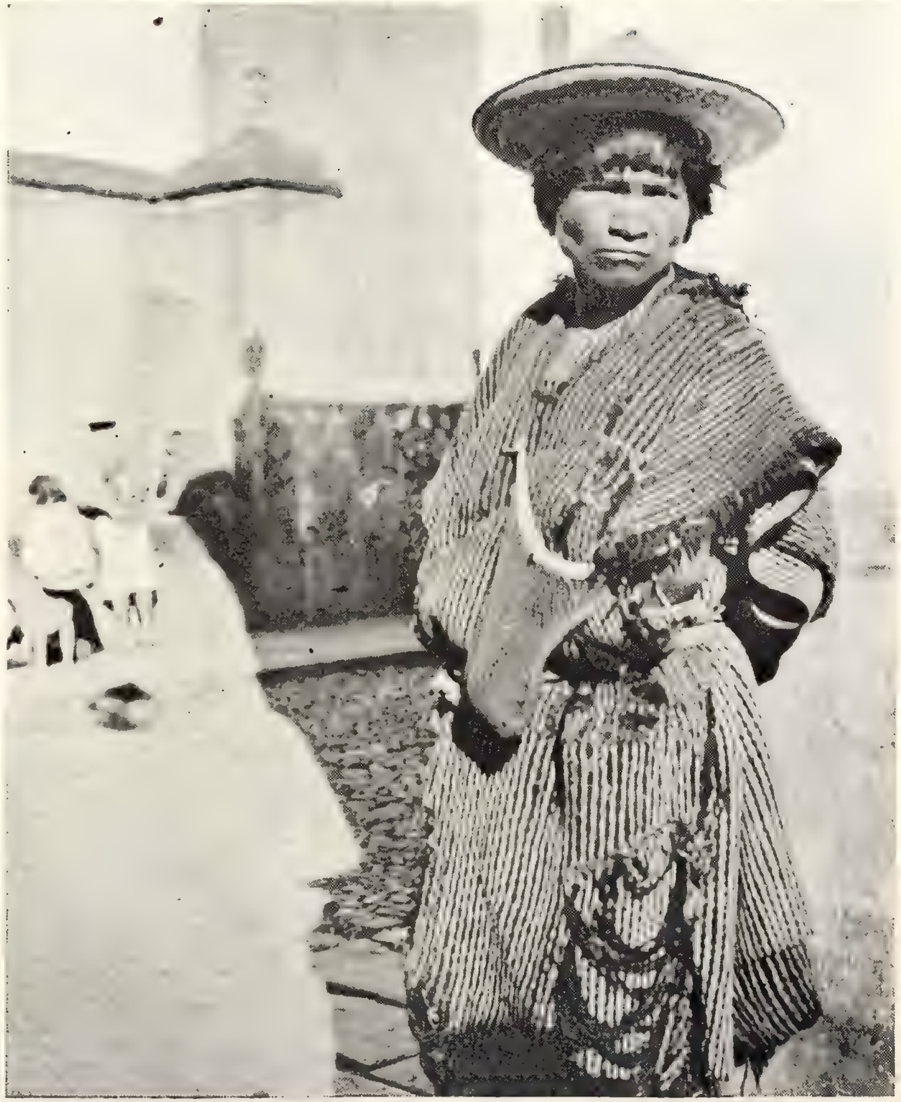


WOMAN GINNING COTTON: SAN BARTOLOMÉ

NATIVE COTTON LOOM: SAN BARTOLOMÉ



INDIANS OF SAN CRISTOBAL



INDIAN OF SAN BARTOLOMÉ

INDIAN WOMEN AT THE FOUNTAIN: SAN BARTOLOMÉ

The method here employed for combating the weevil is to plant the cotton only in alternate years. When Señor Tirado began planting cotton, several years ago, four or five other *finqueros* began planting at the same time. All secured fine returns the first year. Contrary to the advice of Señor Tirado, the others planted the following year and the weevils completely destroyed the crop. Señor Tirado waited until the others had planted for three successive years, each time the crop being a complete failure, when all gave it up. He then waited another year and planted again with good results and has secured good crops every alternate year since. The off year he plants corn, beans, tobacco, etc., and gets good use of the land. He naively says that cotton yields so abundantly that one ought to be satisfied with planting every other year.

From Señor Tirado we also obtained five varieties of Indian corn that are admirably adapted to dry conditions. They mature here in from 40 to 60 days.

Grain weevils are a serious pest at Rosario, and Señor Tirado has adopted several ingenious methods to prevent their ravages. He protects beans by storing them in cow-hides, which are sewed up and the seams sealed with lime. He states that they will keep indefinitely in packages of this kind.

A common custom in these regions is to plant a climbing species of bean in the corn fields soon after the corn is planted. The short-season corn matures and is doubled before the beans make much growth, and as soon as the corn is harvested the stalks serve as poles for the beans.

From Rosario we proceeded to Tuxtla, spending several days en route. Here we were introduced to the Governor of Chiapas, who gave us letters of introduction to the various alcaldes and leading men of the towns which we were to visit. He also sent telegraphic orders to these officials that they prepare quarters for us and aid us in every way possible. There is so little travel in this part of the country that without such aid it is often difficult to secure men or animals. We also met a number of influential people who were interested

AN INTERESTING FRUIT FOUND IN THE MARKET OF SAN CRISTOBAL, MEXICO

Although belonging to the Solanaceæ, the odor and taste of this fruit are very similar to that of a fine cantaloupe. The fruits are almost seedless, the flesh firm, of fine texture, and very refreshing.

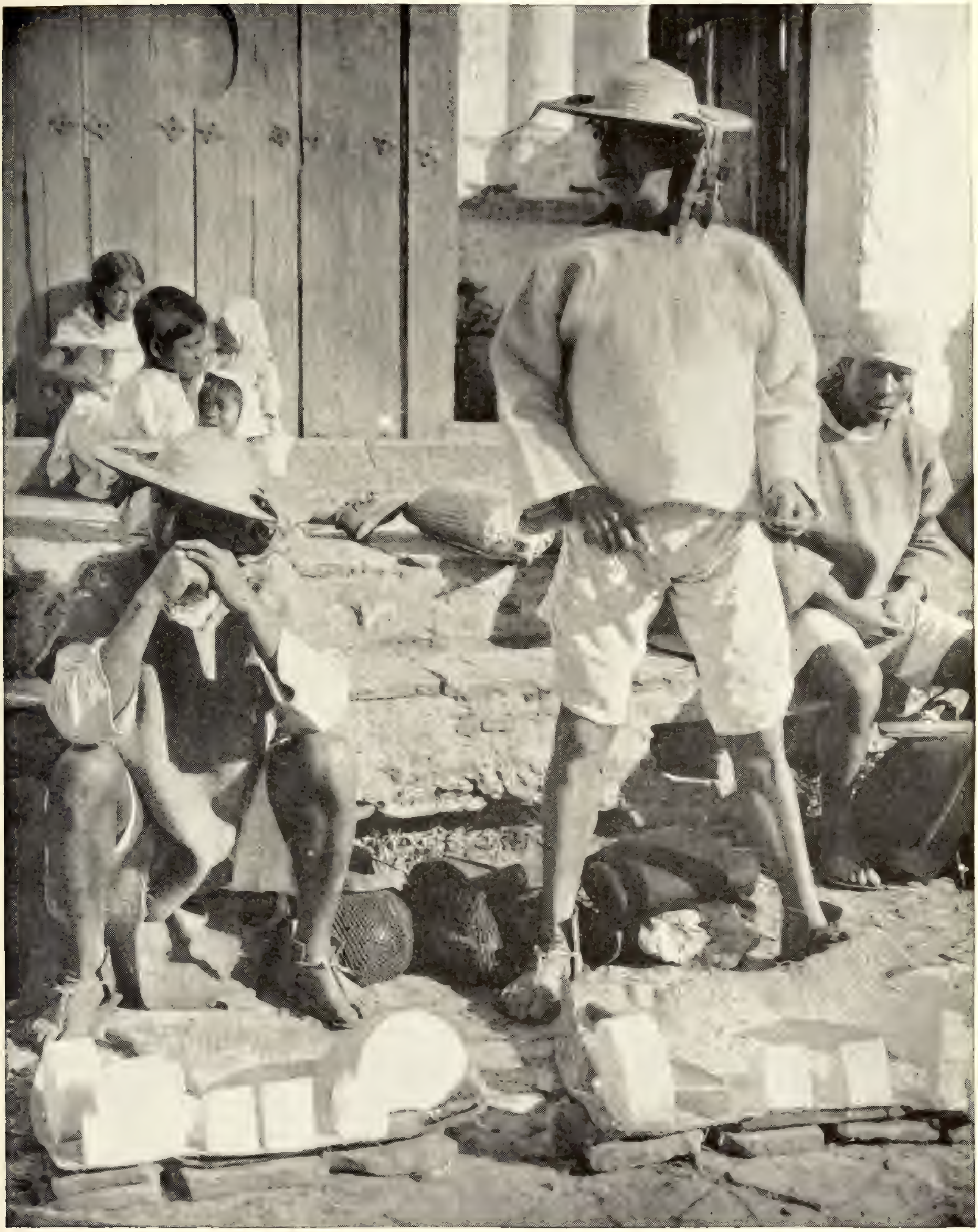
in agriculture and who gave us much valuable information and data from which we could plan our further movements.

In the market at Tuxtla we found a quantity of cotton said to have come from Acala. The bolls were exceptionally large, running 38 to the pound.

Inquiry about the town also led to the discovery of a very interesting small-bolled cotton, known here as "culluche." The variety is without economic importance, but it shows such weevil resistance that it seemed worthy of careful study. The plants are perennial, those seen being about 10 feet high with trunks about 3 inches in diameter. They were heavily loaded with very small bolls and still flowering, the lint being short and brown in color.

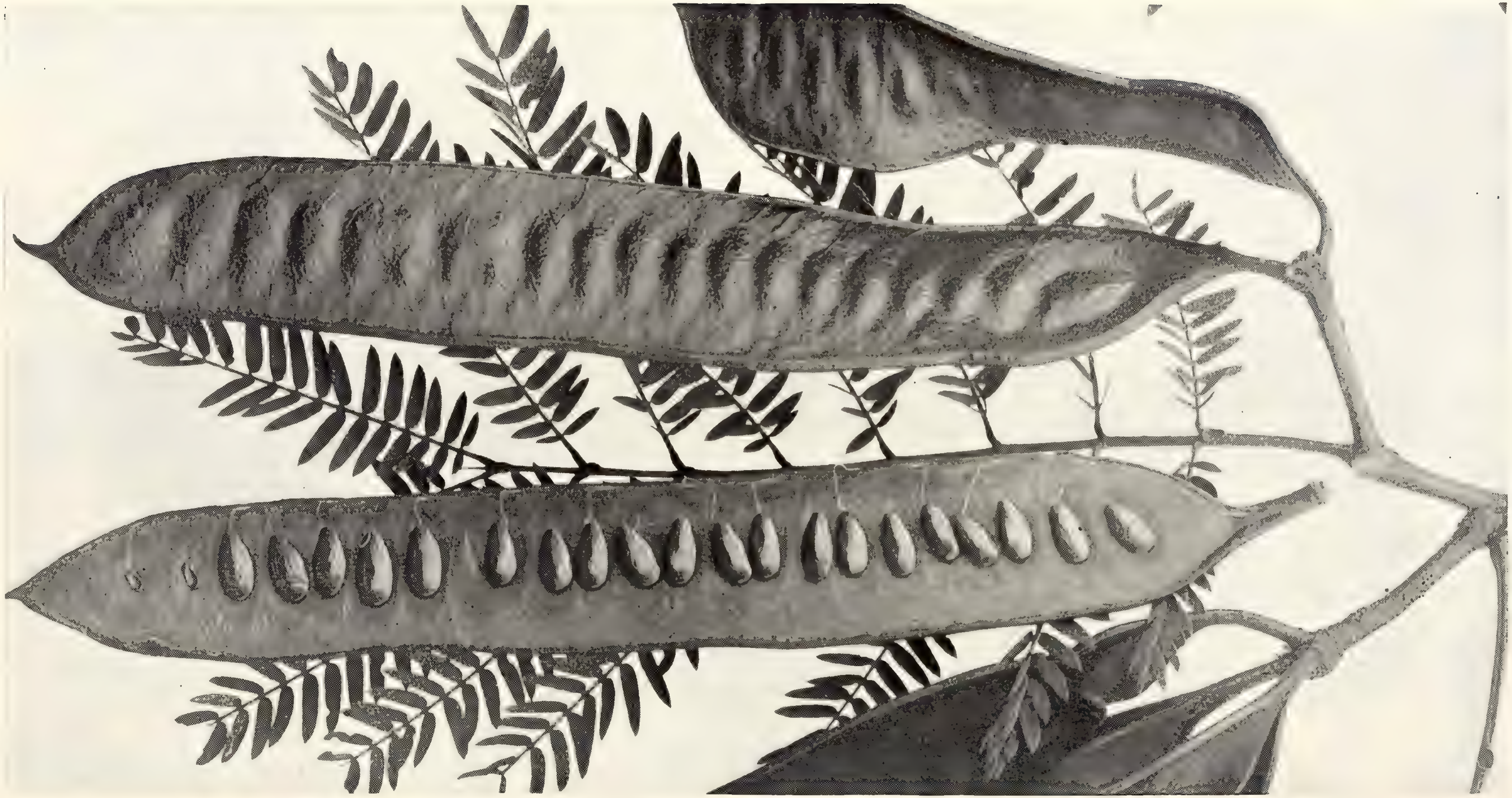
Weevils were present in large numbers, but were doing comparatively little damage. The bolls are protected by proliferation much more completely than in any cotton thus far studied. Hardly a single boll could be found which had not been punctured, but in all the bolls opened we could not find a single live larva. In fact the proliferation was so complete that the bolls were hardly deformed, although as many as 7 or 8 eggs had been laid in a single boll. Proliferating tissue had formed to such an extent that it was forced out through the opening and dried as a coiled mass on the outside of the boll. In many cases these coiled masses, if straightened out, would be at least two inches long (see page 305).

Curiously enough the buds of this cotton showed no proliferation whatever. They were protected, however, in a very interesting manner. The bracts were tightly closed except at the base, where there was a small aperture, and in nearly



MARKET SCENE AT SAN CRISTOBAL

The white blocks that the Indians have for sale are chicle, which is an important constituent of chewing-gum. The streamers on the man's hat indicate he is unmarried and has a sweetheart (see page 315).



THE LEUCÆNA SEED

A food of considerable importance among the Indians of southern Mexico is the seed of several species of *Leucæna* that are eaten raw. The custom is widespread. Specimens were found offered for sale in the market of Mexico City, Oaxaca, and in all the towns of Chiapas that we visited. At least four species were collected. These seeds did not appeal to our palates, but the Indians appear to be very fond of them.

every case examined this opening was closed by the web of a small jumping spider (*Aysha minuta*). The protection thus afforded, though by no means so complete as in the case of the bolls, is still very effective. Practically the only time that the weevils can gain access to the bud is just as the flower is opening the bracts. The only use that is made of this cotton here is in the decoration of the altars which every house contains at Christmas time.

Although the country from Tuxtla to Chiapas showed every indication of being subject to severe drought, almost all the land is under cultivation. Corn and henequen are the principal crops. This district is very densely populated, the houses, each in a small yard, being so thick along the road that the impression is given of a continuous town all the way from Chiapas to Rivera de Cupia. At this point the road leaves the Chiapas River, and the country gradually rises and becomes still drier.

Near El Faro the land was more open, with sufficient grass to support numbers of cattle, the raising of which is the principal industry. It being Christmas eve, there was a demonstration in the church at the hacienda, after which, amid fireworks and the beating of drums, an image of the Child was carried to the bank of the river, where the entire population remained until daybreak.

The town of San Bartolomé is old and very picturesque. The buildings are of stone, with tile or thatched roofs, and the streets are paved with large flat stones. All the vacant spaces between the houses are filled with high stone walls, so that the streets are narrow alleys of stone.

In the plaza are the ruins of an old church, the nave of which has been entirely destroyed by earthquakes, leaving only the towers. There is a large Indian population in and about the town who speak the Tzotzil language.

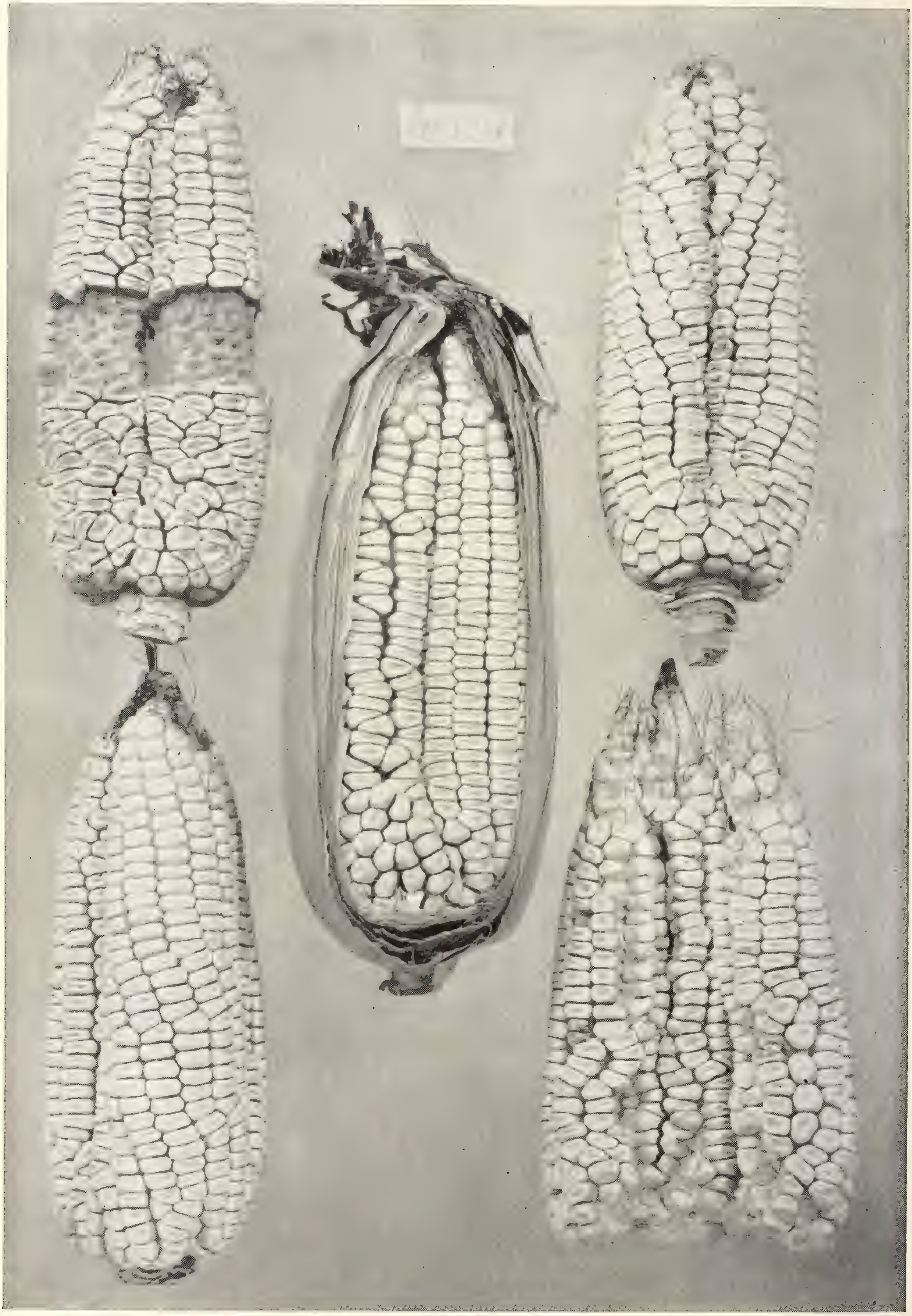
Cotton is grown by both the Indians and the Mexicans, and is planted only in alternate years. This custom is probably an aboriginal one and the Mexicans copy it from the Indians. No one could be found who had the faintest idea as to why the cotton failed to do well if planted every year. It is another instance of primitive people being right in practice without knowing the reason why. Unfortunately this was the year in which no cotton was planted, and the only place where cotton was being grown at the time of our visit was at San Sebastian, a finca located about three leagues southeast of San Bartolomé.

Here the corn is planted about the middle of May, the cotton in August, and the beans in September—all in the same field. The corn is doubled in November or early December and remains in this condition until after the cotton is picked, so that the harvesting of the corn may not injure the cotton.

Our visit was well timed for the study of this cotton, as the bolls were just beginning to open. Weevils were present in great abundance on all the cotton bushes, which were five or six feet high, but it was nevertheless apparent that a good crop would be secured. The bulk of the crop is set on the long basal branches close to the ground, where the bolls are practically exempt from the attacks of the weevils.

There could be little doubt that the plant protected itself from the weevils by bearing its crop close to the ground, as hardly a punctured square or boll could be found except on the upper part of the plant. The crop was said to be not unusually large, but it would compare very favorably with anything I have seen in the United States. We were told that in ordinary years it is necessary to pick 50 yards of a row in order to secure one arroba, or 25 pounds, of seed cotton. As the cotton is planted one yard each way, this would amount to 2,420 pounds seed cotton per acre, or about 800 pounds of lint. This seems an incredibly large yield for land that was also producing a crop of corn and beans, but from the appearance of the plants I am inclined to believe that it is not far from right. The region toward the river, where cotton is grown only in alternate years, is said to produce even larger crops.

The yield of corn at San Sebastian must have been correspondingly large. The hills were planted at the same dis-



THE FAMOUS DOUBLE-EARED CORN OF TUXTLA (SEE PAGE 319) tance as the cotton, with four or five stalks in each hill. Very few sterile stalks could be found, and most of the stalks bore two or three well formed though rather small ears. The plants before being doubled must have been about 8 feet high.

The greater part of the inhabitants of this place are pure Indian. The men have straight, coarse, black hair reaching almost to their shoulders. The lips are thick, but otherwise the features are quite like those of the Indians of Guatemala. They wear a red cloth, tied like a turban, about the head, a short "guipil" or shirt like that of the women, and full white trousers that are usually tied in at the bottom, making them look like Dutch trousers. The women are very short and well formed. They wear a short "guipil," usually white or with very little color, and a dark-blue cloth wrapped around the hips. Their chief decoration takes the form of embroidery of this blue cloth, which they do in silk of various colors. Some of the more elaborate cloths are valued as high as $10 or $12 gold.

From San Bartolomé the road passes around the base of the mountain on which the town is located, and at a distance of about one league enters the oak forest. Soon after this the pines appear and the characteristic plants of the lower levels disappear.

Our course led up the valley of a small river, along the banks of which the vegetation was more luxuriant, mahogany and cedar trees being not uncommon. At an elevation of 4,000 feet, the country became more open and *Brahea* palms appeared. Our road continued to rise until it crossed a high ridge amid magnificent pines and oaks, and the town of Teopisco came into view in a flat valley entirely surrounded by high mountains. The elevation of the town is 5,300 feet, and the night before our arrival there had been a hard frost and nearly all the vegetation was black. We spent a night at Teopisco, and in the morning the white frost could again be seen on the ground and roofs.

We left for San Cristobal early in the morning of December 31. The road continued to ascend and for nearly the whole day we traveled through magnificent forests of pine and oak. The trees were very large, with little or no undergrowth, the absence of which is probably due to the sheep, which are pastured in the forest in large numbers. Toward night we crossed a high ridge, probably 7,000 feet, and descended to the valley in which San Cristobal is located.

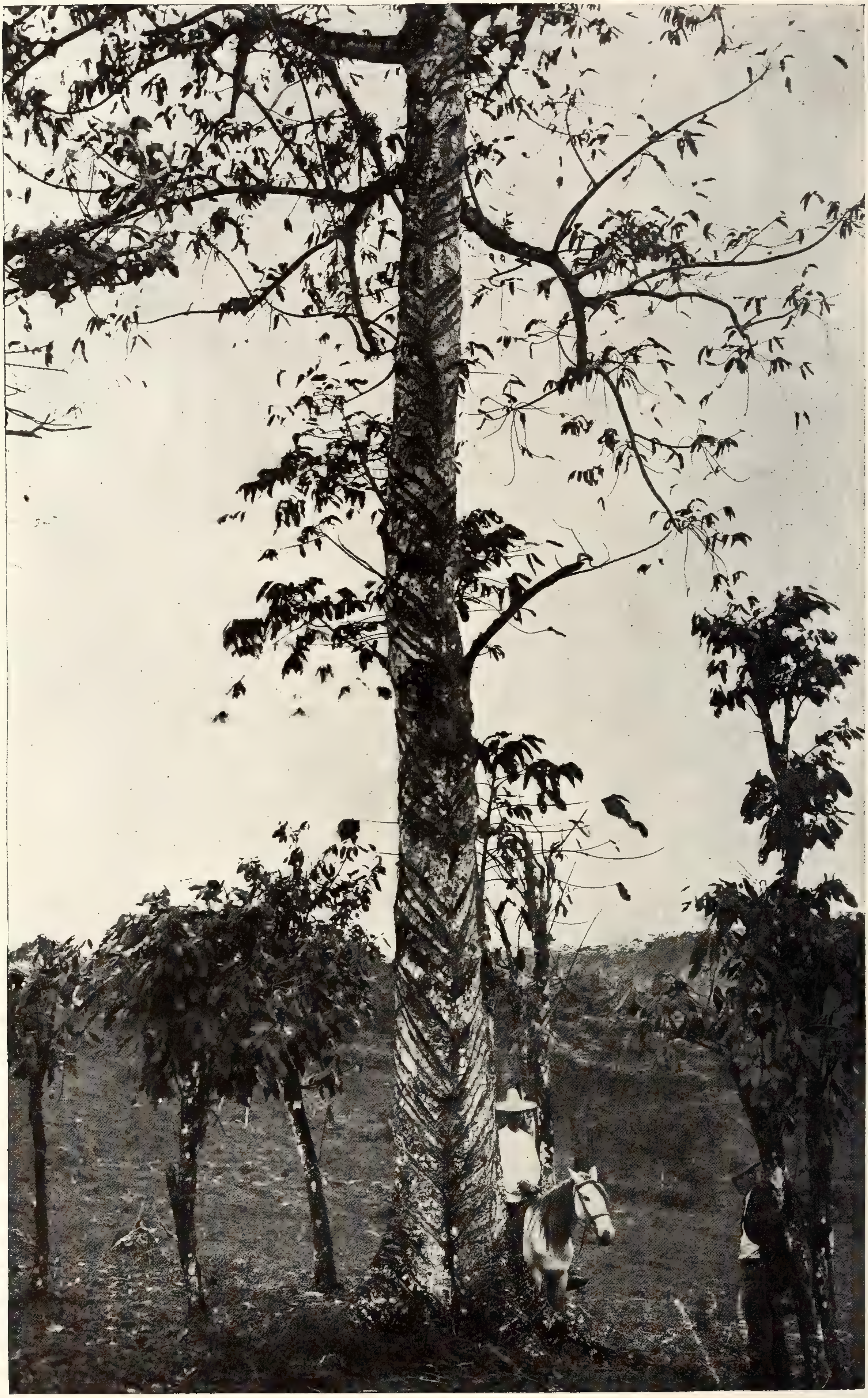
San Cristobal, like Bartolomé, was at one time the capital of the State, but its inaccessibility was sufficient reason for removing the seat of government. It is more closely associated with the civilization of the western part of Guatemala than with other parts of the State of Chiapas. Frost occurred every night of our stay and is usual at this time of year. Here we secured seed of a wheat which is cultivated on the very steep slopes near the tops of the mountains about the town, in the hope that the variety might be of some historic interest, this region being so isolated that the variety is probably one that has been grown here from very remote times.

Seeds of a fine avocado were secured. As this entire region is subject to frost, snow sometimes falling at San Cristobal, the variety will probably prove to be resistant to cold. The exact locality from which the fruit came could not be ascertained, but trees were seen which had withstood the frost better than orange trees and where most of the vegetation was killed back.

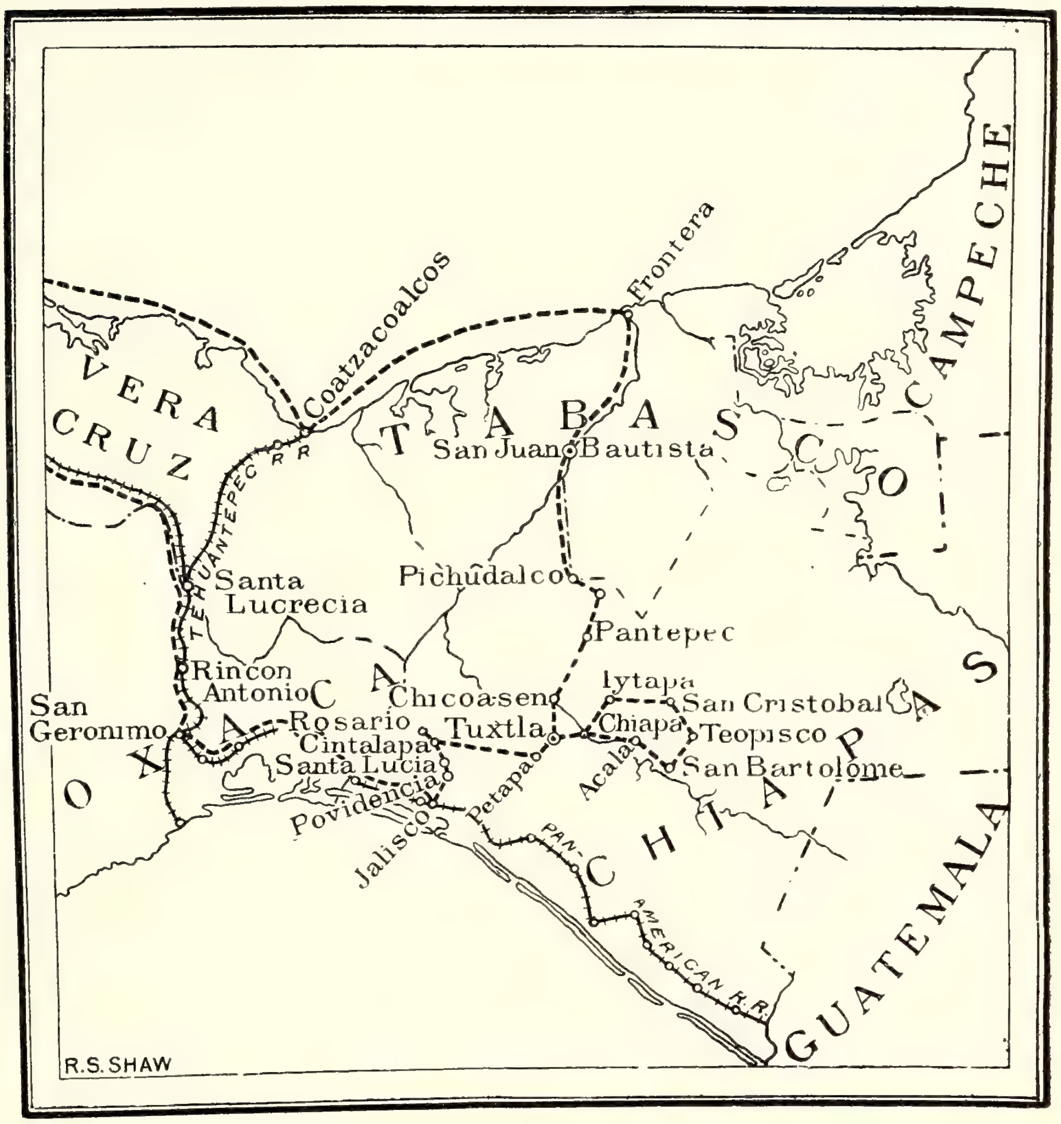
There is a considerable Indian population about San Cristobal. They dress in coarse woolen blankets with a hole for the head, or in short woolen shirts. They wear very low-crowned straw hats decorated with ribbons, which give them a very ludicrous appearance. The streamers on the hats indicate that the man is unmarried and has a sweetheart.

We started on our return for Tuxtla on the morning of January 2, taking the road that leads through Ixtapa.

The road descends steadily. For a long distance practically the only trees are the oaks, and for three or four leagues these have been pollarded to secure fire-wood



LARGE CASTILLA RUBBER TREE: CHIAPAS (SEE PAGE 320) for San Cristobal, which has caused the trees to assume grotesque, dwarfed forms. Effects of frost were evident until we descended to about 4,000 feet. A fine feature of this day's trip was a stretch where the road followed the bank of the Osumatinta River through a gorge, the sides of which ranged between 500 and 1,000 feet high. The side of the gorge opposite the road was covered with a rank growth of ferns and other vegetation, rare in these regions.

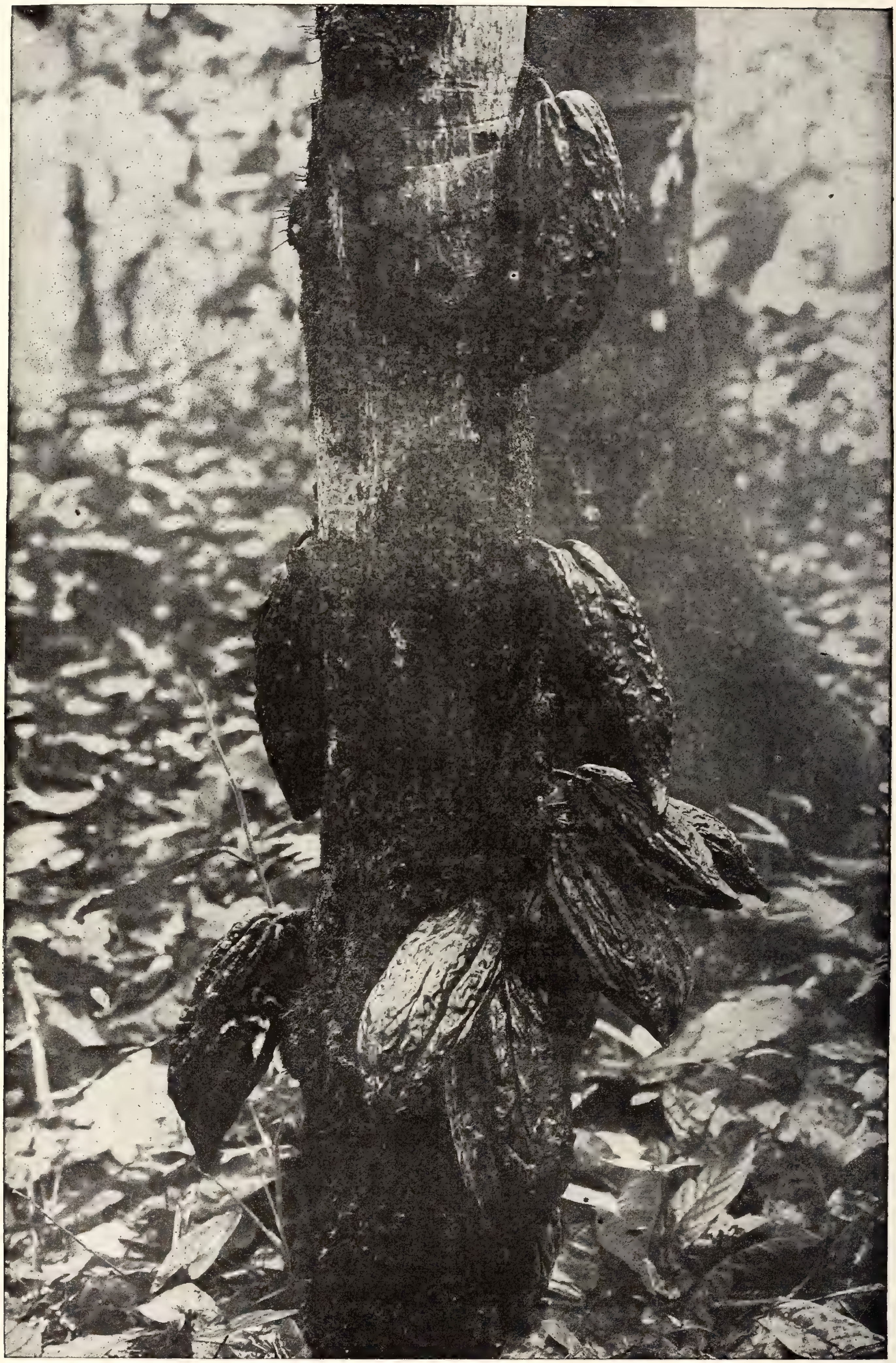


SKETCH MAP OF SOUTHERN MEXICO, SHOWING THE ROUTE OF MESSRS. COLLINS AND DOYLE

The oaks around Ixtapa have also been pollarded to furnish fuel for the town. For miles about all the towns in this region every piece of available wood has been removed and fuel has often to be carried a distance of 10 or 12 miles on the backs of Indians. As soon as the higher ridge is reached the whole valley of the Grijalva is visible from the top of an almost perpendicular cliff about 2,000 feet high. The view is more like that from a balloon than anything we had ever seen. The descent from here is constant and a very severe strain on the ears.

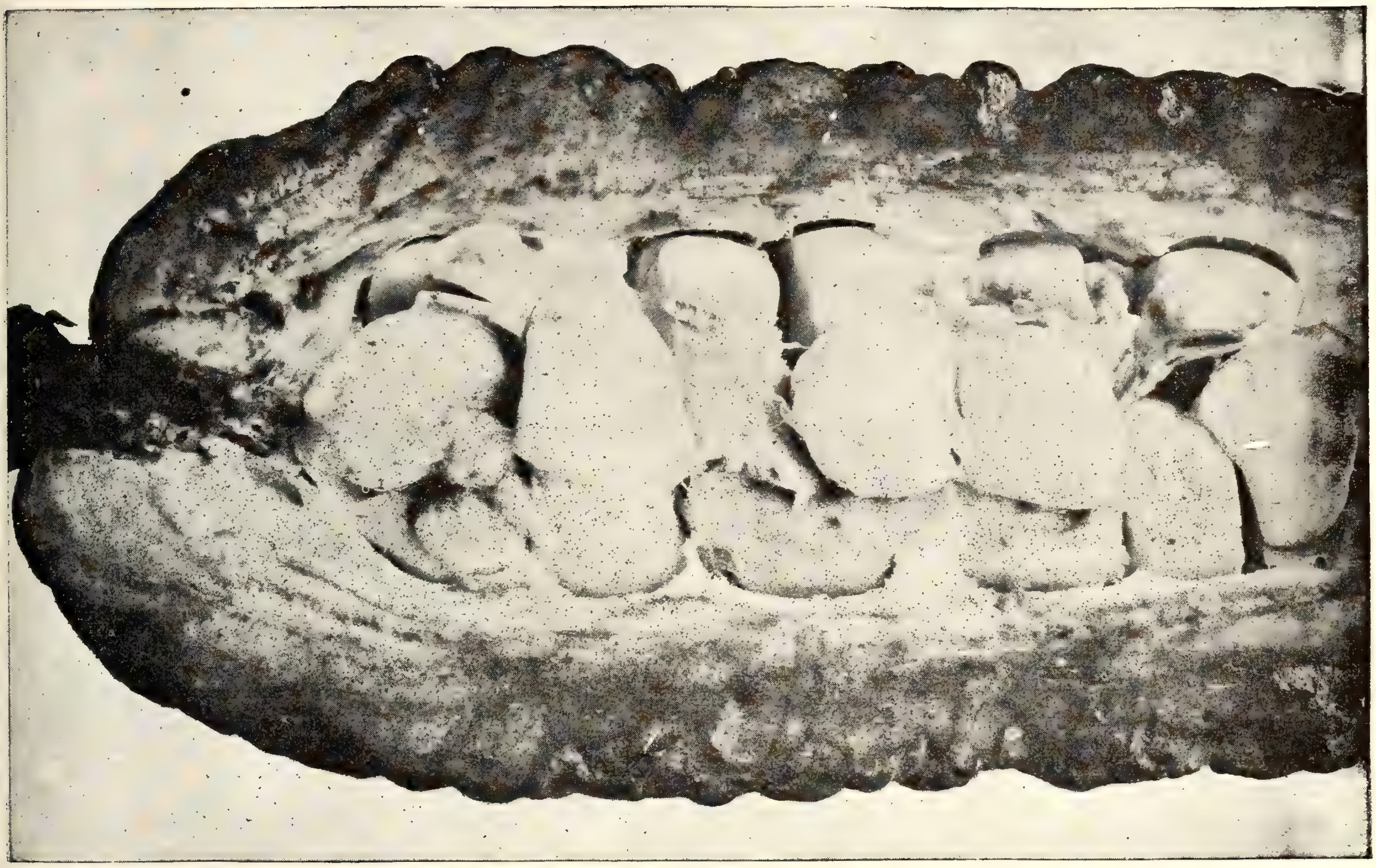
While in Tuxtla we secured samples of a curious double-eared corn that was at first thought to be merely an abnormality. We soon found these ears in such quantities, however, as to lend color to the statements of the natives that this was a real variety that always came true to seed. It is certainly not a case of simple fasciation, for the ears are not grown together, but have branched just inside the husk. Kernels are borne entirely around each of the branches. We secured specimens with three branches, and four are said to be not uncommon. Aside from the peculiar form of the ears, this corn is a type distinct from anything else found at Tuxtla, and every ear that we saw had at least two branches. It is one of the most popular varieties here and is said to yield very good crops.

As an evidence of the isolation of Tuxtla and to show the extent to which primitive customs still prevail, the fact may be mentioned that cacao is still used as money in the market, a custom that was general in many parts of tropical America at the time of the discovery. A common expression for cheap articles in the market is that they sell so many for a "cinco." This originally meant 5 cacao beans, but to allow for the fluctuating value of the cacao a "cinco" actually consists of from 2 to 5 cacao seeds, but the ratio will be uniform throughout the



TRUNK OF CACAO (CHOCOLATE) TREE: PICHUCALCO

Showing the peculiar position in which the fruit grows. Cacao beans are still used as money at Tuxtla



AN OPENED POD OF CACAO (SLIGHTLY REDUCED)

Cacao was appreciated by the Mexicans long before the discovery of America. Prescott writes that the Emperor Montezuma was "exceedingly fond of it, . . . no less than 50 pitchers being prepared for his own daily consumption; 2,000 more were allowed for that of his household." Seventy-three per cent of the cacao used by the world comes from tropical America and the West Indies (Ecuador, Brazil, Trinidad, Santo Domingo, and Venezuela); 23 per cent from Africa (principally Portuguese East Africa), and the rest from Ceylon and the Dutch East Indies.

market. In making a purchase the necessary question is, "Cuanto es cinco?" (How many are five?) The money value of the "cinco" is about ½ cent, Mexican.

A drink that is common here, and one that we found very useful in making long trips where there was little food available, is "tascalate." It is made of parched corn, ground and mixed with ground cacao and almonds, and is conveniently carried in the form of a powder. It is only necessary to add sugar and a little water to make a pleasant and very nourishing drink.

Soon after passing Santa Rita the ascent becomes more rapid and the pines and oaks become larger. A broad plateau is soon reached, covered with a moist forest, that reminds one strongly of the forests of our northern States, except that everything is on a larger scale. The oaks are more like the species at home, and sweet-gum trees that appear identical with those at home are not uncommon. Many of the oaks and pines are 3 feet in diameter and very tall. As we crossed the edge of this plateau and descended into the humid tropics to Pantepec, the transition was very abrupt; tree ferns, Musaceæ, and Zingiberaceæ suddenly appeared in abundance.

The town of Pantepec has an elevation of about 5,000 feet. The inhabitants are Indians, but speak a dialect distinct from the Indians of Tuxtla. We found but two people in the entire town that could speak Spanish, yet they are all devout Catholics.

Pichucalco, two days by trail from Pantepec, is a rabbling town that presents a very striking appearance from the fact that nearly all the houses are painted a bright blue. It is of considerable importance as a center of cacao and rubber growing, but is isolated and seldom visited. The usual means of communication with the outside world is to the north instead of by the route over which we came, but even in this direction it is necessary to make a three or four days' journey in a dug-out canoe from San Juan Bautista in order to reach the town. In early Spanish times Pichucalco was connected with San Cristobal and the other towns to the south by a paved road, the remains of which can still be seen.

The rubber plantations here are very old, the trees having been first planted as shade to cacao. In making experimental tappings of a considerable number of trees we were impressed with the great difference of yield between apparently identical trees that were growing side by side, which proves conclusively that all estimates of yield based on the tapping of a small number of trees are entirely worthless. At the finca Concepcion, about three leagues from Pichucalco, we found rubber trees measuring over 9 feet in circumference at 5 feet from the ground. These trees were estimated to be at least 50 years old.

From experimental tappings it was estimated that the tree shown on page 316 should yield at least 12 pounds, and the owner of the finca stated that about that amount had been taken from this tree at former tappings. The trees are tapped to a great height, the "uleros" ascending by means of climbers.

Our experimental tappings at Coahuila disclosed the important fact that the trees do not recover from the effects of tapping with anything like the rapidity that has been supposed. An old tree perhaps 40 years of age was selected. It had been tapped a number of times and always on the same side, the last tapping having been made about a year before our visit. Cuts were made with a 2-inch chisel and it was found that on the side which had been previously tapped hardly a trace of latex could be secured, while on the opposite side on clean bark the flow was enormous, 80 cc. of latex being secured from a single 2-inch cut. With cultivated trees the yield cannot be expected to keep up after the first two or three tappings, even if these are deferred until the trees are 10 or 12 years old.

No plantation devoted exclusively to the growing of rubber has yet proved to be a commercial success, but the output of cultivated rubber from southern Mexico is rapidly increasing.

The cacao at Coahuila produces the largest pods that we have ever seen. They are all of the white-seeded type; but, unlike most of the white-seeded cacaos, the pods have very thick shells; the seeds are large with an unusual amount of pulp.

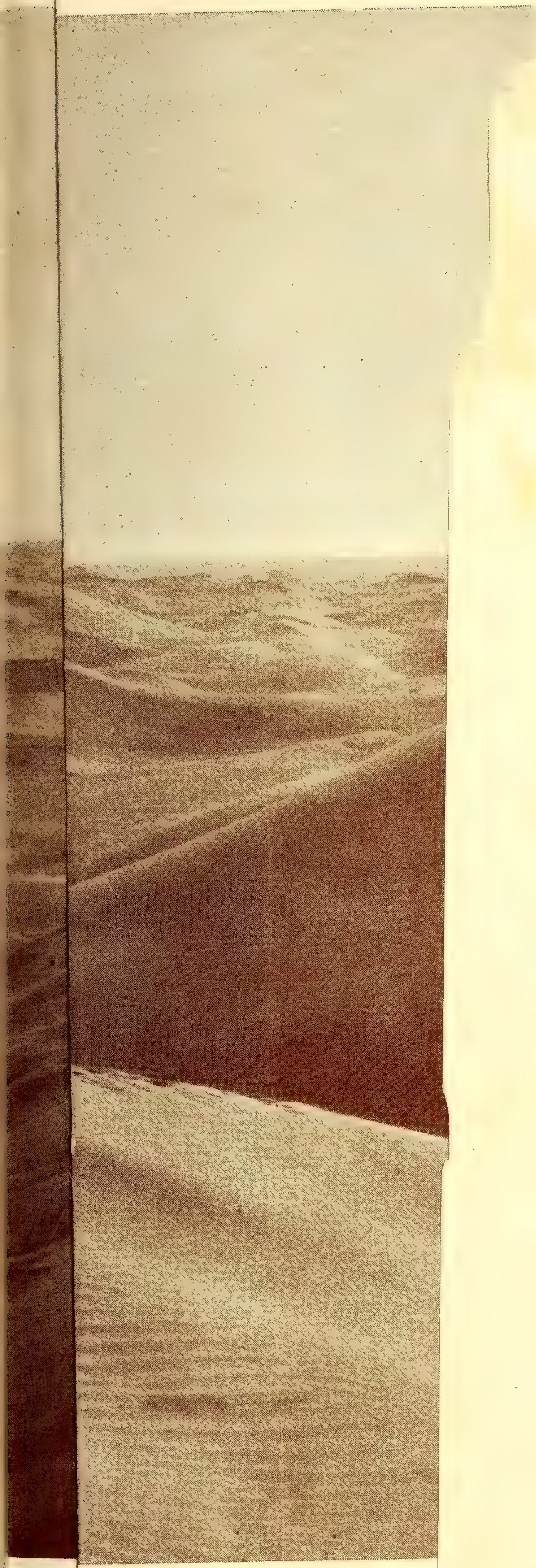
The trees are well fruited and the pods are for the most part borne close to the ground. The crop is almost continuous from November to June, although there are three chief pickings. The seeds are unfermented and sell for 50 cents, Mexican, per pound at Pichucalco.

As soon as the seeds are removed from the pods they are washed by placing them in shallow baskets partly submerged in water and rubbing them against the bottom and sides of the baskets, forcing the pulp through the meshes. The seeds are then sun-dried, the quicker the better, it is thought. This unfermented product would not command a high price in the European or American markets, but it is said that the Mexicans do not demand a fermented bean. The price which they get would seem to make suggestions for improvement superfluous.

From a few miles below Pichucalco to within a few miles of San Juan Bautista the banks of the river are almost continuous cacao plantations, a great part of which is shaded with rubber.

About 1,500 tons of cacao pass through San Juan Bautista annually, valued at about $1,250,000. In spite of the enormous amount of cacao produced in Mexico and an import duty of 30 cents per kilo, cacao is still imported from Guayaquil. In the fine cacao lands above San Juan Bautista the growing of this commodity is the most lucrative agricultural operation with which we are familiar.

H. GROSVENOR, Editor



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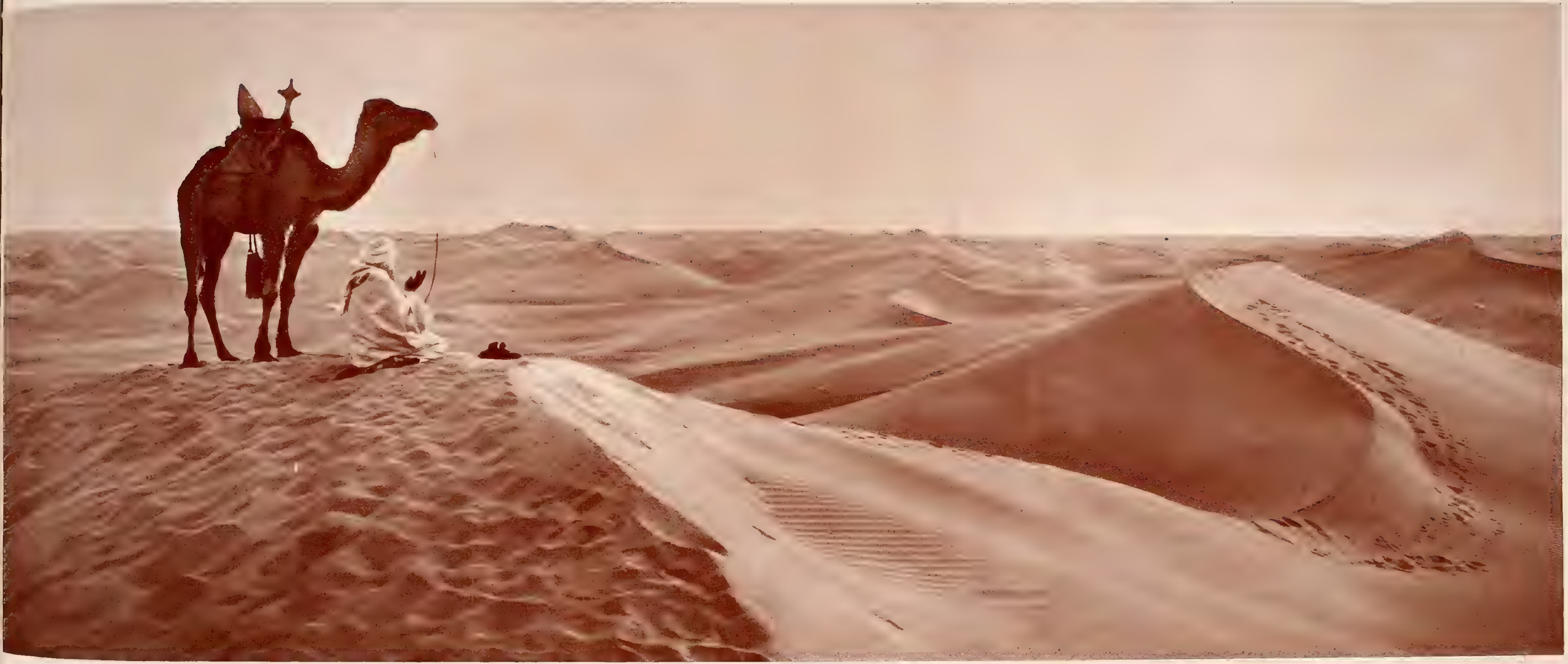
Supplement to the NATIONAL GEOGRAPHIC MAGAZINE (Washington, D. C.), April, 1911. GILBERT H. GROSVENOR, Editor



THE HOUR OF PRAYER: IN THE SAHARA DESERT

Photo by A. Bougault; Copyright, 1911, by National Geographic Society

Time is not here, nor days, nor months, nor years,
An everlasting NOW of solitude.
—ROBERT SOUTHEY

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THE NATIONAL GEOGRAPHIC MAGAZINE

PESTS AND PARASITES

Why We Need a National Law to Prevent the Importation of Insect-Infested and Diseased Plants

By Charles Lester Marlatt

Of the Bureau of Entomology, U. S. Department of Agriculture

With Photographs from the U. S. Department of Agriculture

THE United States is the only great power without protection from the importation of insect-infested or diseased plant stock. Referring to European powers only, Austria-Hungary, France, Germany, Holland, Switzerland, and Turkey prohibit absolutely the entry from the United States of all nursery stock. Our apples and other fruits are admitted only when a most rigid examination shows them to be free from infestation. Most of the other European countries have very strict quarantine and inspection laws, and the same is true of the important English and other colonial possessions.

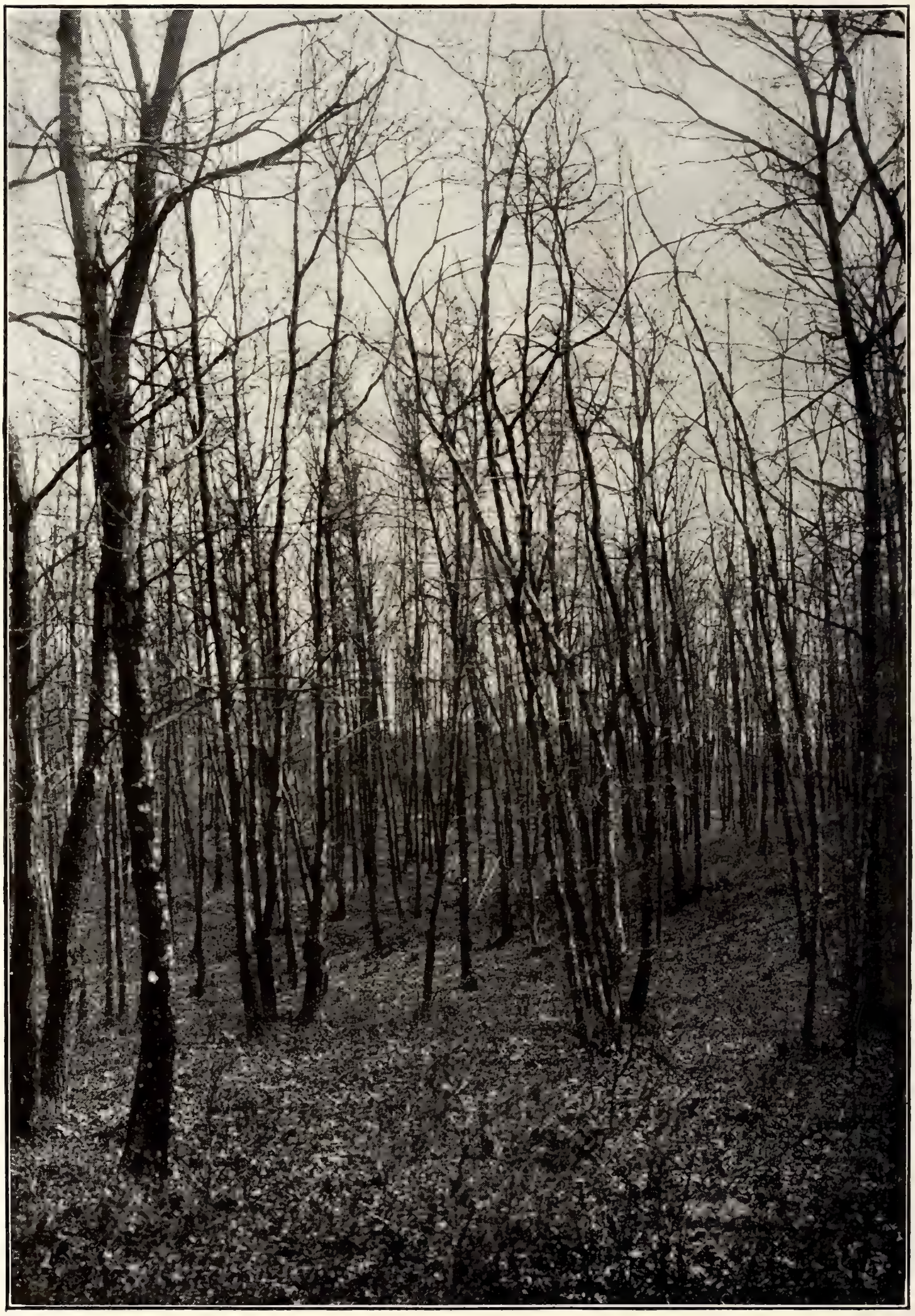
The United States thus becomes a sort of dumping ground for refuse stock. Diseased live-stock may be, and are, excluded by law, but diseased or insect-infested plants have no bar against their introduction.

A properly enforced quarantine inspection law in the past would have excluded many, if not most, of the foreign insect enemies which are now levying an enormous annual tax on the products of the farms and orchards and forests of this country.

FOREIGN ORIGIN OF MANY OF OUR INSECT PESTS

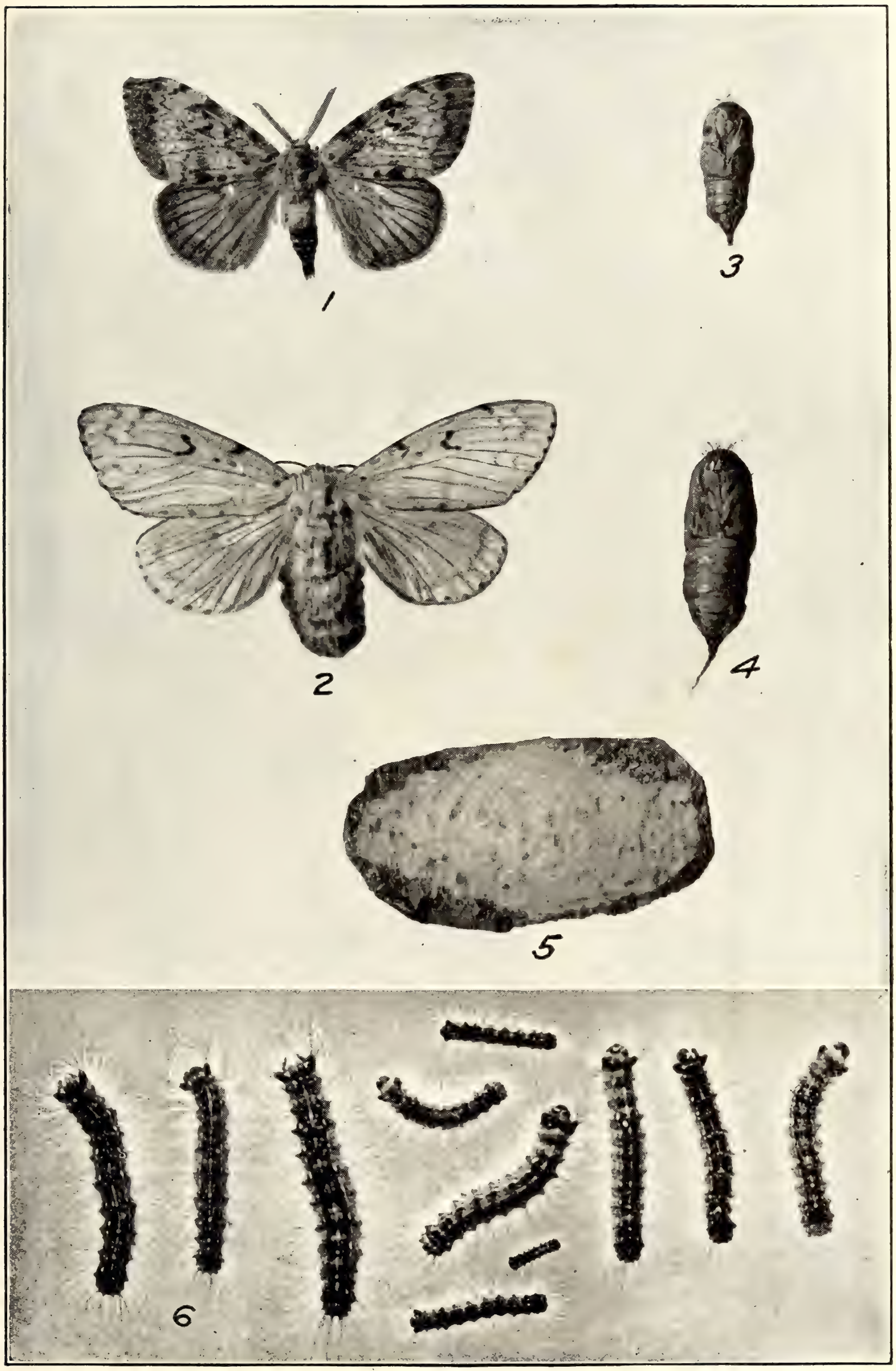
Fully 50 per cent of the important injurious insect pests in this country are of foreign origin. Among these are the codling moth, the Hessian fly, the asparagus beetles, the hop-plant louse, the cabbage worm, the wheat-plant louse, oyster-shell bark louse, pea weevil, the Croton bug, the Angoumois grain moth, the horn fly of cattle, and in comparatively recent years have been introduced such important pests as the cotton-boll weevil, the San José scale, the gypsy and brown-tail moths into New England, the Argentine ant into New Orleans, and the alfalfa-leaf weevil into Utah.

While it is true that certain classes of injurious insect pests, such as the house fly and other household insects which may be similarly carried in ships' cargo or in the packing of merchandise, have been imported, and still will be, in spite of any quarantine law, however rigid, it



TREES THAT HAVE BEEN COMPLETELY STRIPPED OF LEAVES BY THE GYPSY MOTH

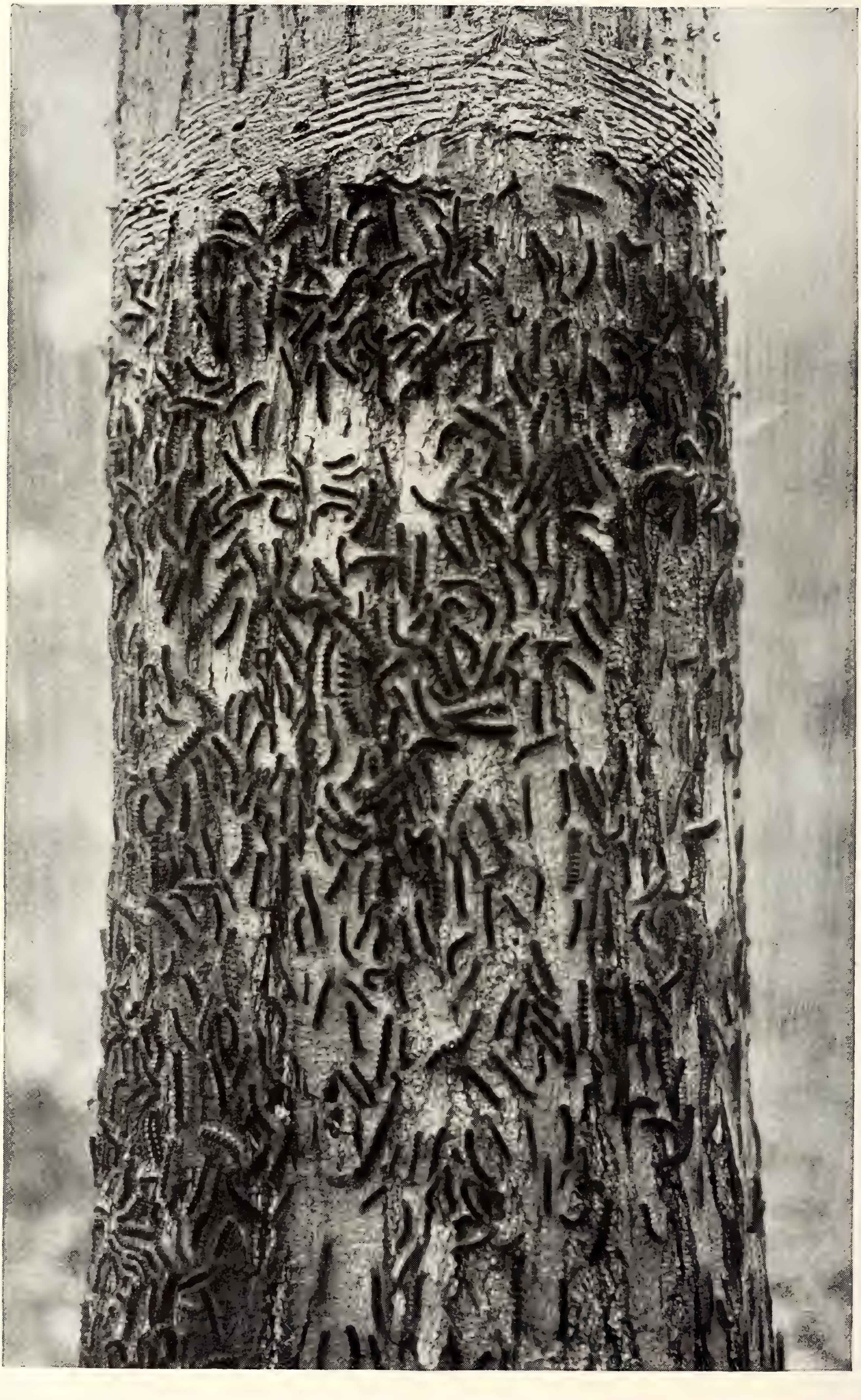
This picture of a woodland at Lexington, Massachusetts, was not taken in midwinter, but in July



THE GYPSY MOTH (*Porthetria dispar*)

Fig. 1. Male moth. Fig. 2. Female moth. Fig 3. Male pupa. Fig. 4. Female pupa. Fig. 5. Egg cluster. Fig. 6. Caterpillars; the largest are less than half grown.

The gypsy moth is one of the worst forest pests of Europe. It was accidentally introduced into Massachusetts 40 years ago, and has now spread to the adjacent States of Connecticut, Rhode Island, New Hampshire, and Maine. It has been recently brought into this country on imported stock and taken to such widely isolated points as Louisiana and Ohio. There is grave risk of its becoming distributed over the entire United States. It has already cost in New England, in mere efforts at control, a good many millions of dollars, and should it become widespread in the United States, damage from it would be beyond calculation. Every effort should be made to prevent a further introduction of this and other equally serious forest pests from Europe and Asia.



GYPSY-MOTH LARVÆ PREVENTED FROM ASCENDING THE TREE BY A BAND OF TANGLEFOOT

This is one of the efficient means of control, and especially for the protection of trees adjacent to infested territory

MASS OF GYPSY-MOTH LARVÆ WHICH HAVE COLLECTED UNDER A BAND OF BURLAP

After the larvæ are half grown they seek for shelter during the day, and will collect under burlap bands in enormous numbers, where they can be readily destroyed

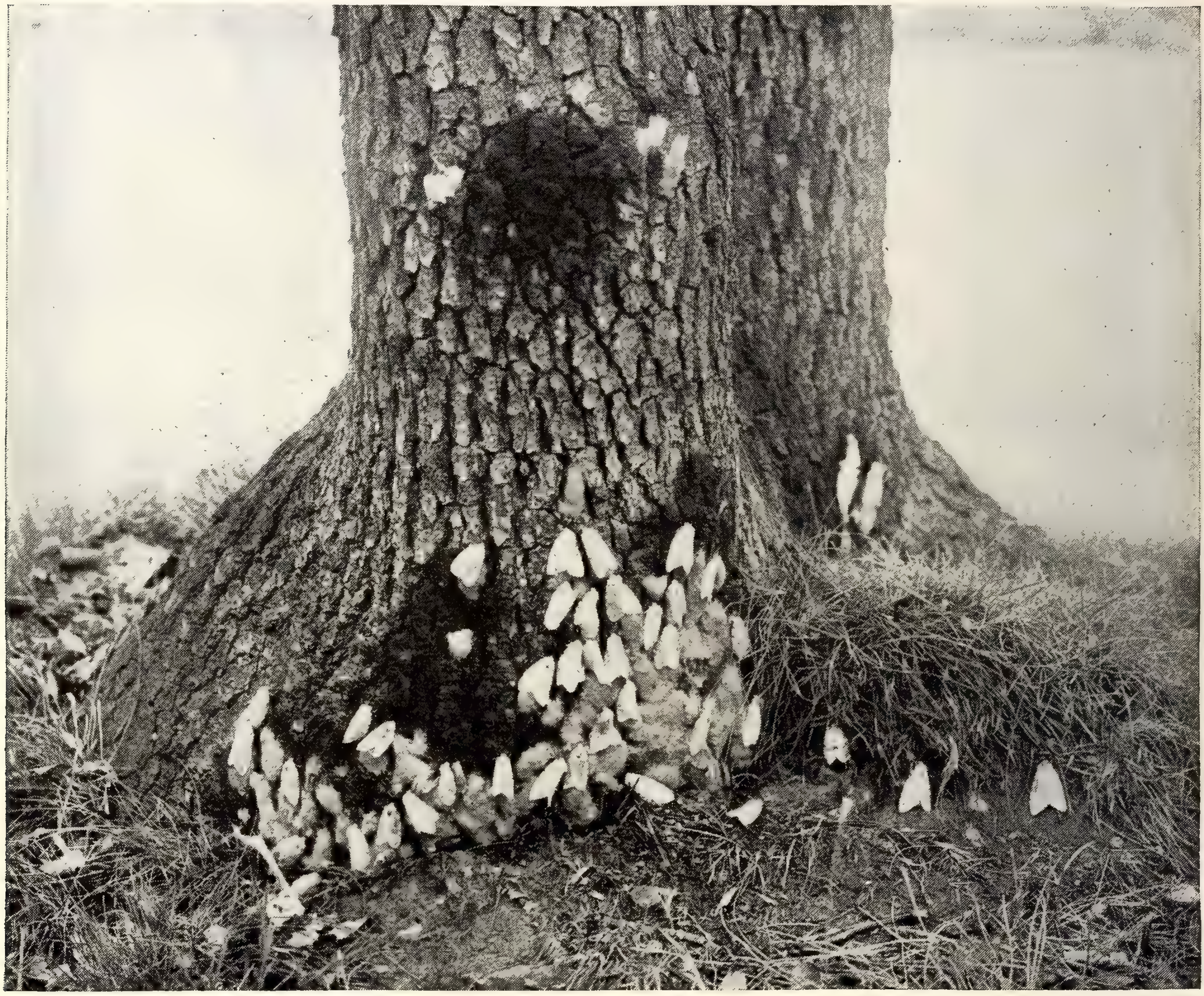
is essentially true that the great mass of the foreign insect enemies of orchards and forests have come in on nursery and ornamental stock, and might have been kept out, in large measure, if an efficient quarantine had been in operation.

THESE IMPORTED INSECTS COST US MANY MILLIONS OF DOLLARS YEARLY

The codling moth, or apple worm, occasions a loss, in cost of spraying trees and injury to fruit, of 16 million dollars a year; the San José scale, similarly in loss of product and cost of treatment of trees, 10 million dollars a year; the Hessian fly, the most important enemy of wheat, probably causes an annual loss of 50 million dollars, and in some years this loss has reached the enormous total of 100 million dollars. The cost to this country of the cotton-boll weevil, from the very conservative estimate of Mr. W. D. Hunter, amounts to about 25 million dollars a year. All these were imported.

The Argentine ant is destroying citrus orchards in Louisiana, and has spread to the orange groves of southern California; the alfalfa-leaf weevil, probably introduced on packing of nursery stock from Europe, has destroyed hundreds of fields of alfalfa in Utah, and is spreading to adjacent States.

The gypsy and brown-tail moths in Massachusetts and portions of other New England States are now costing those States, in expenditures merely in efforts at control, not counting damage at all, upward of a million dollars a year. In addition to this, the national government is appropriating $300,000 a year to aid in controlling these pests along the highways, and by this means check their more rapid distribution. In spite of these



FEMALE GYPSY MOTHS DEPOSITING EGG-MASSES AT THE FOOT OF AN OAK TREE

Each female deposits a mass containing from 400 to 500 eggs. The light oval patches between the moths are such egg-masses

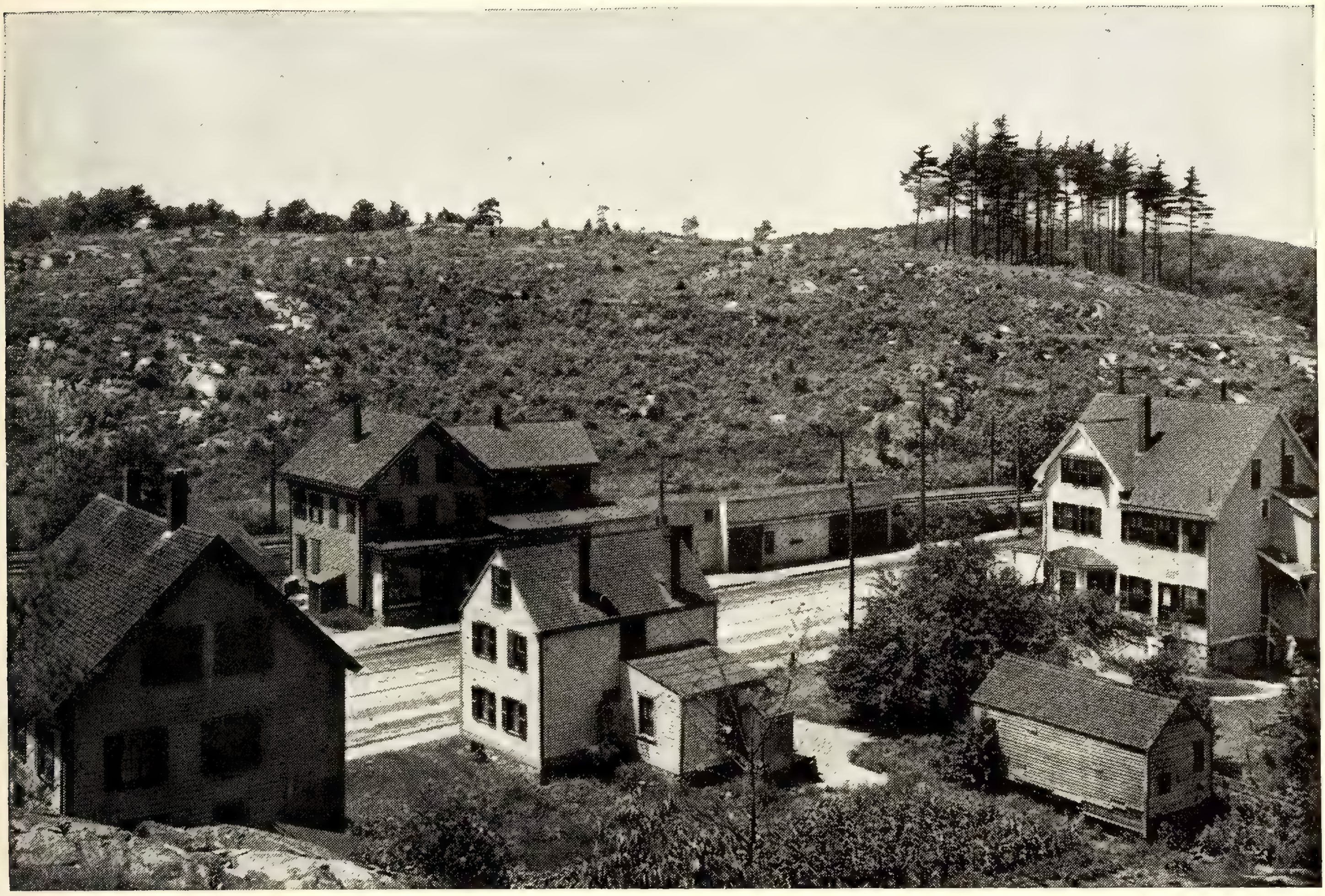
efforts and this enormous expenditure, these insects are slowly spreading, and great damage is done yearly to woodlands, private grounds, and orchards. The dissemination of these two pests over the whole United States, as is extremely likely under present conditions, would entail a like cost throughout the country—a tremendous and unnecessary charge on our fruit and forest interests.

Very careful estimates, based on crop reports and actual insect damage over a series of years, show that the loss due to insect pests of farm products, including fruits and live-stock, now reaches the almost inconceivable total of one billion dollars annually. The larger percentage of this loss is due to imported insect pests, and much of it undoubtedly would have been saved if this country had early enacted proper quarantine and inspection laws.

DANGER OF ADDITIONAL PESTS BEING IMPORTED

Great as is the number of foreign insect pests already imported and established in the United States, there remain many others with equal capacity for harm, which, fortunately, have not yet reached our shores or crossed our borders; or, at most, have infested only a limited part of our domain.

Our increasing business relations with China and other Oriental countries adds enormously to the risk of the importation



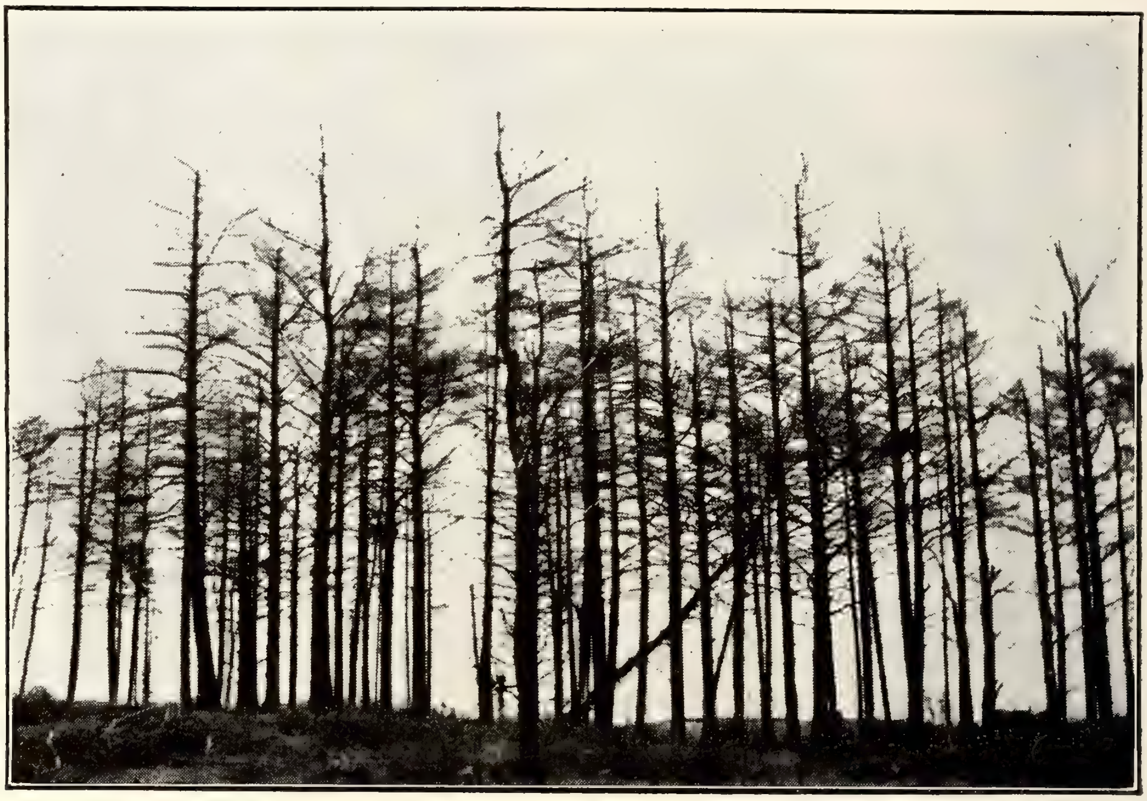
THE DEFORESTED HILL, WITH ITS UGLY FIELD OF STUMPS, SHOWN IN THIS PICTURE, WAS ONCE A BEAUTIFUL PINE GROVE

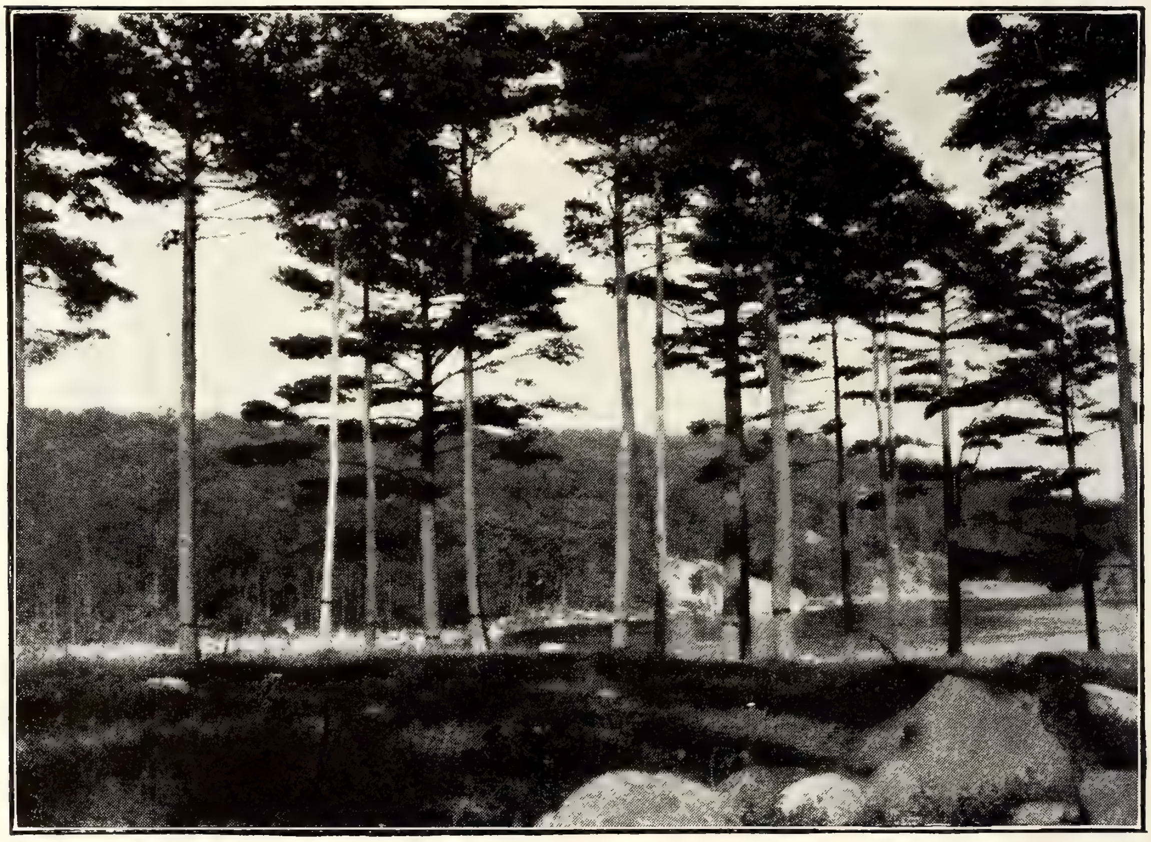
As the gypsy moth had stripped the trees of their foliage, they had to be cut down, because pine trees will not recover from a single stripping of their leaves. Elms, maples, and other deciduous forests will usually stand two or three defoliations.

of new pests. We know very little of the injurious insect pests of those countries, and particularly of China, but the importation of new stock in the last year or two, from China especially, has demonstrated the existence there of many pests which have not hitherto been known. The power of harm of these new pests is abundantly illustrated by the San José scale, which is one of the earliest of the Chinese insect pests to reach us, and undoubtedly came to this country with some ornamental nursery stock sent from north China.

Among the known foreign insect fruit pests which it is very desirable to keep out of this country are the Morellos fruit worm, which is an important enemy of citrus fruits in certain parts of Mexico; the olive-fruit worm, which occurs throughout the Mediterranean countries where the olive is grown; the mango-seed weevil, which has been found in imported mango seed during the present year; several fruit-scale pests known to occur in China, Japan, and other Oriental countries, which have records for harm quite as great as the San José scale; the gypsy and brown-tail moth to regions in this country where they do not now occur, and many other equally dangerous insect enemies of fruit trees, forest trees, and farm crops, known to occur in foreign countries.

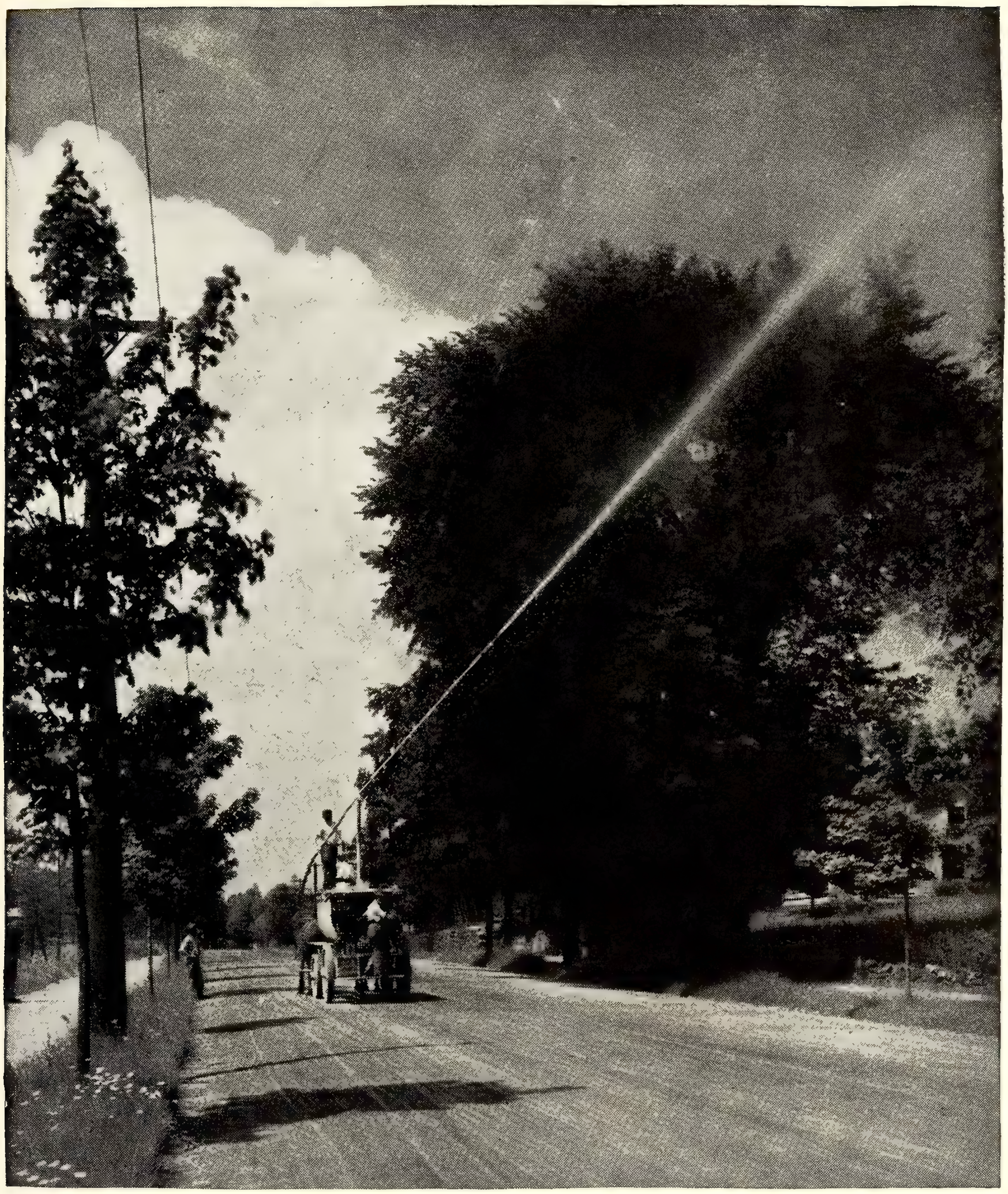
In addition to the danger of importing these insect pests is the risk of bringing in new and dangerous plant diseases. Two illustrations of this danger only will be mentioned, but there are many others equally important. First may be noted a new disease of the potato, known as the "potato wart," which there is grave risk of establishing in this country. This disease, once in the soil, destroys the





PINE GROVE KILLED BY THE GYPSY MOTH (SEE PAGE 339)

PINE TREES THAT HAVE BEEN PROTECTED FROM THE ATTACKS OF THE GYPSY MOTH BY BURLAPPING AND OTHER MEANS

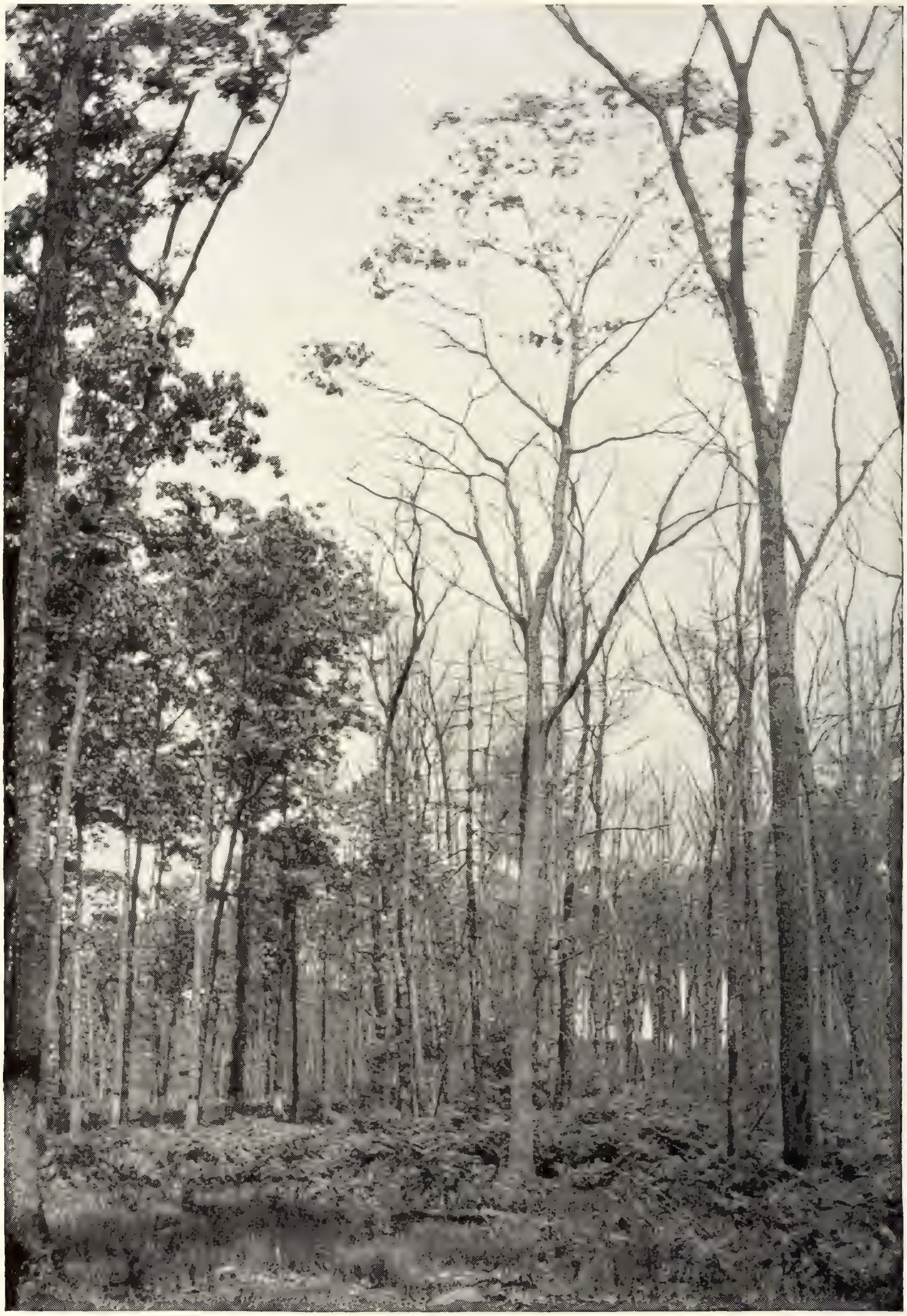


A HIGH-POWER SPRAYING APPARATUS TREATING A MASSACHUSETTS ROADSIDE WITH AN ARSENICAL WASH TO DESTROY GYPSY AND BROWN-TAIL MOTH CATERPILLARS

Note the water tower, by means of which the tops of the tallest trees can be reached with the poison spray. The National Government is spending $300,000 a year in such roadside work in an effort to prevent the rapid spread of the gypsy moth by carriage of caterpillars dropping from roadside trees on vehicles and automobiles, one of the principal means of spread.

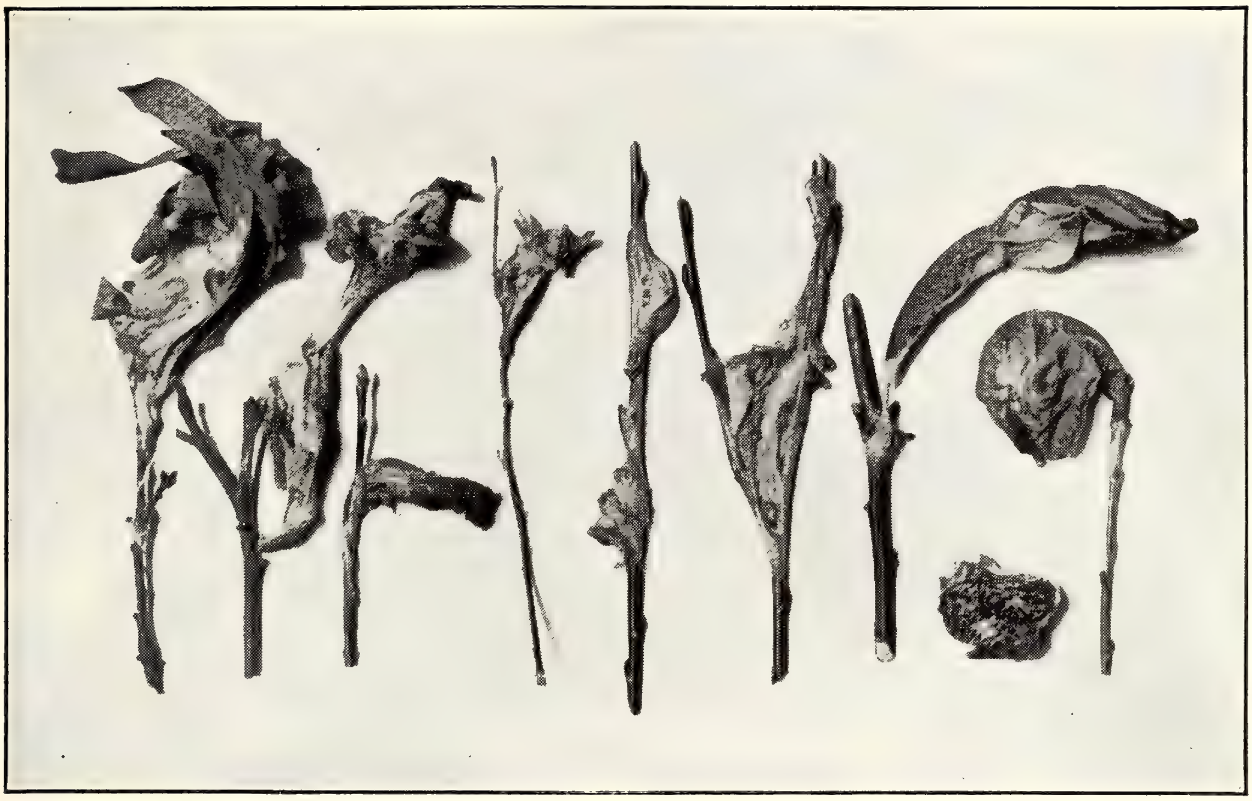
potato tuber and prevents the culture of this staple. The disease was discovered in Hungary in 1886, and has since spread over portions of Europe and into England, where it is causing great alarm. It has also established itself in Newfoundland, and it is especially from this source that the danger to the United States comes. There is no known remedy for the disease, and its existence in the soil practically puts an end to potato culture. Its introduction into the United States would result in the loss of millions of dollars annually.

The other disease is the "white-pine blister-rust," which has caused enormous losses in Europe, particularly to nursery stock. This disease has, during the last



PHOTOGRAPH TAKEN IN AUGUST, 1910, BORDERING A ROADSIDE IN MASSACHUSETTS

The protected trees on the left border the road and have been sprayed; the trees to the right, further from the road, have not been treated, and have been practically stripped of their leaves by gypsy-moth caterpillars.

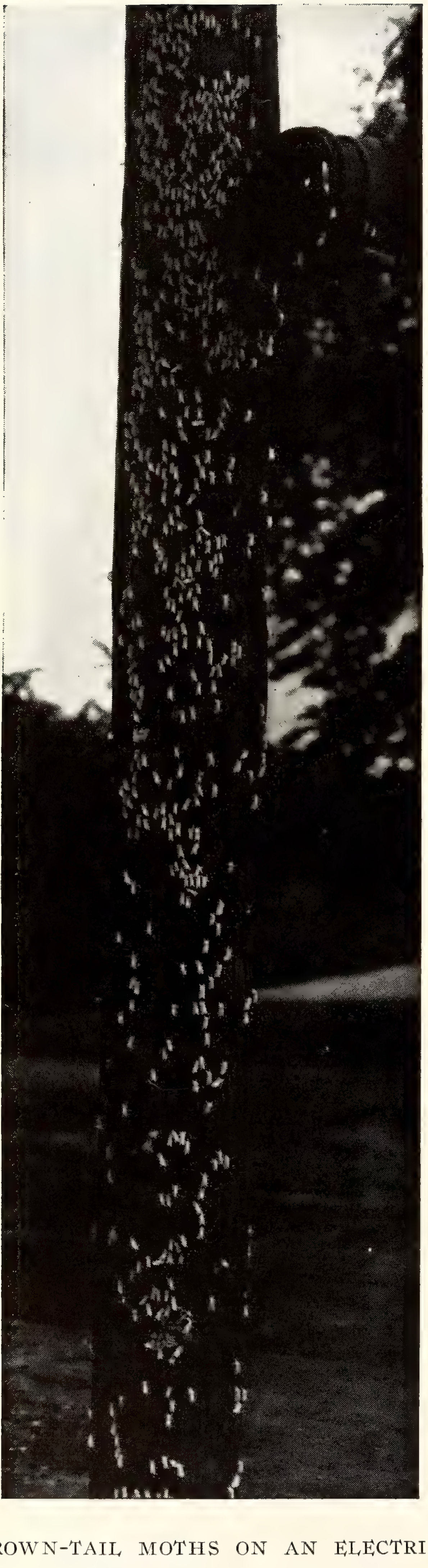


WINTER NESTS OF THE BROWN-TAIL MOTH, CONSISTING OF LEAVES AND WEB ATTACHED TO TWIGS

In these nests from 300 to 400 minute larvæ pass the winter

PILE OF 120,000 WEBS OF THE BROWN-TAIL MOTH GATHERED AND DESTROYED AT YORK, MAINE

York Harbor, Maine, has become thoroughly infested with the brown-tail moth. This illustration is a photograph of a pile containing 120,000 of the winter nests of the brown-tail gathered and destroyed in an effort to free the community from this pest. More than 40 million larvæ were contained in these nests. The brown-tail moth was imported by a Boston florist about 20 years ago on roses from Holland or France. It is a serious enemy of orchard, forest, and shade trees and ornamental shrubbery, and has long been recognized as one of the worst orchard pests of Europe. During the last three years it has been imported in enormous numbers on nursery stock from northern France, Holland, and Belgium, and carried to 22 States. There is no law to prevent such importations. The hairs on the caterpillars produce the brown-tail rash, which often affects residents of infested districts.



BROWN-TAIL MOTHS ON AN ELECTRIC-LIGHT POLE THE MORNING FOLLOWING A FLIGHT*

year or two, been imported on nursery stock into a good many of our States and into the Province of Ontario, Canada. Earnest effort has been made to stamp it out at these points of introduction, and it is hoped that this work has been successful. If this disease becomes established in this country it will result in enormous losses in our pine forests.

Both of these diseases are examples of dangers which can be prevented only by an absolute quarantining of the infested foreign districts, so far as importations therefrom to this country of these particular products are concerned. In other words, these diseases are often not discoverable by inspection, and cannot be destroyed by fumigation. The pine disease may be present in the pine for two or three years before giving any visible demonstration. The potato-tuber disease may be in imported potatoes and similarly escape detection.

EFFORTS TO SECURE LEGISLATION

The necessity for a national quarantine against foreign insect pests and plant diseases has long been recognized, and during the last 14 years, especially, a strong continued effort has been made to secure such legislation. This effort has been blocked very largely by a small body of importing nurserymen, who, careless of the consequences to the country at large, feared some slight check on freedom of their operations. The main body of nurserymen have interests identical with the fruit-growers and are in favor of protective legislation, and *The National Nurseryman,* the principal organ of the nursery trade of this country, has taken positive stand in support of such legislation.

The entire value of the imported nursery stock, as declared at customs, which is thus menacing the safety of this country is about $350,000 annually—scarcely more than the government is now appropriating to assist in the effort at the control of the gypsy moth alone in New England.

Some of this imported stock is of ornamentals neither new nor peculiar, and is merely brought in because of cheaper production abroad. A large percentage of it is seedling apple, pear,

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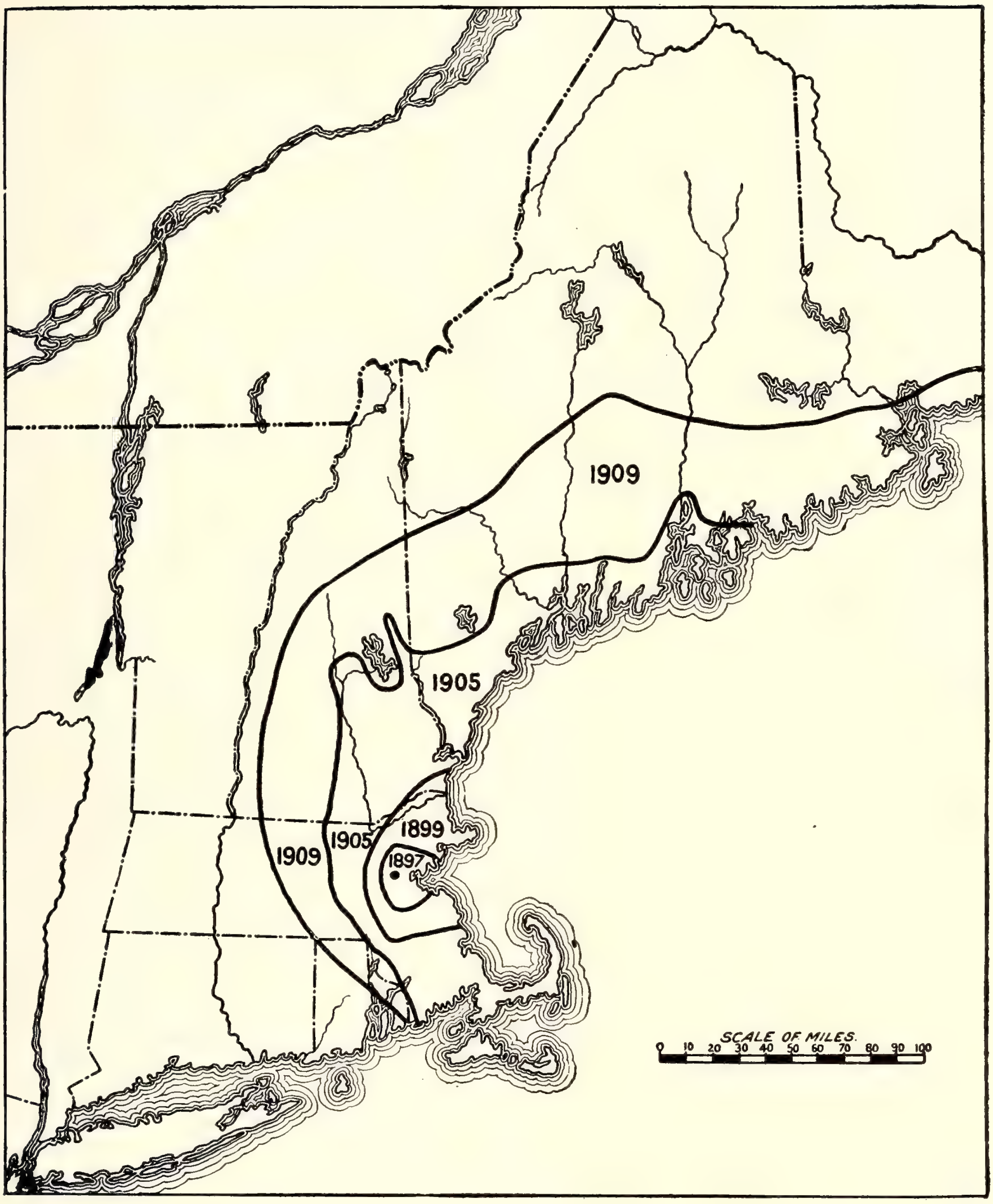
* These moths emerge early in July, are strong fliers, and have spread from the original point of infestation near Boston, northward and eastward, over much of New England. Fortunately the prevailing winds are to the northeast during this season, and their spread to the south and west has been comparatively limited.

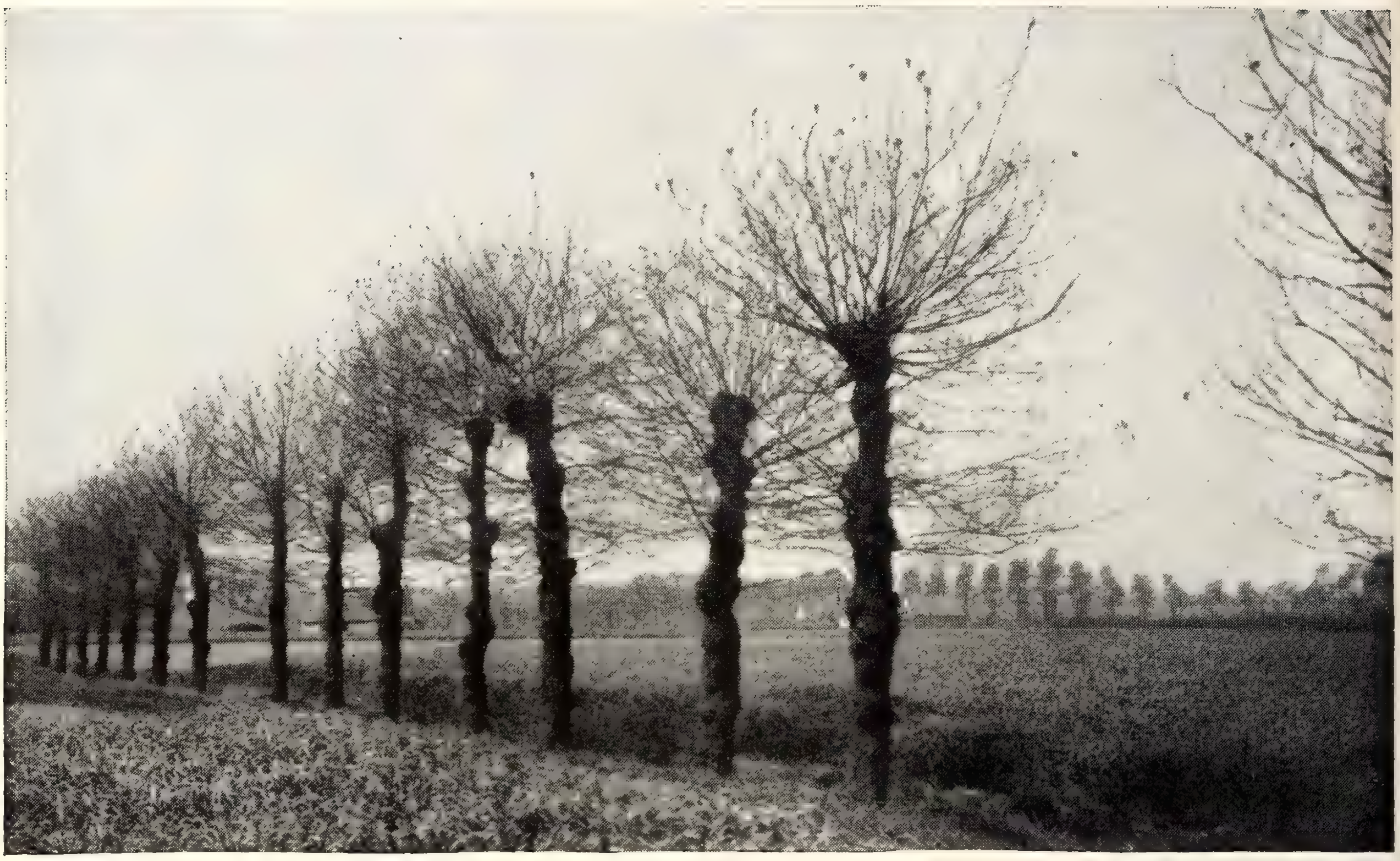


MAP OF NEW ENGLAND, SHOWING AREAS INFESTED BY THE BROWN-TAIL MOTH

This map shows the progressive spread of the brown-tail moth. The prevailing winds during the summer flight in July have carried the insect eastward and northward much faster than southward and westward. This is the insect which is now being introduced on imported nursery stock, and if it gains a foothold in a few interior points its means of rapid spread would enable it to quickly infest the whole country.

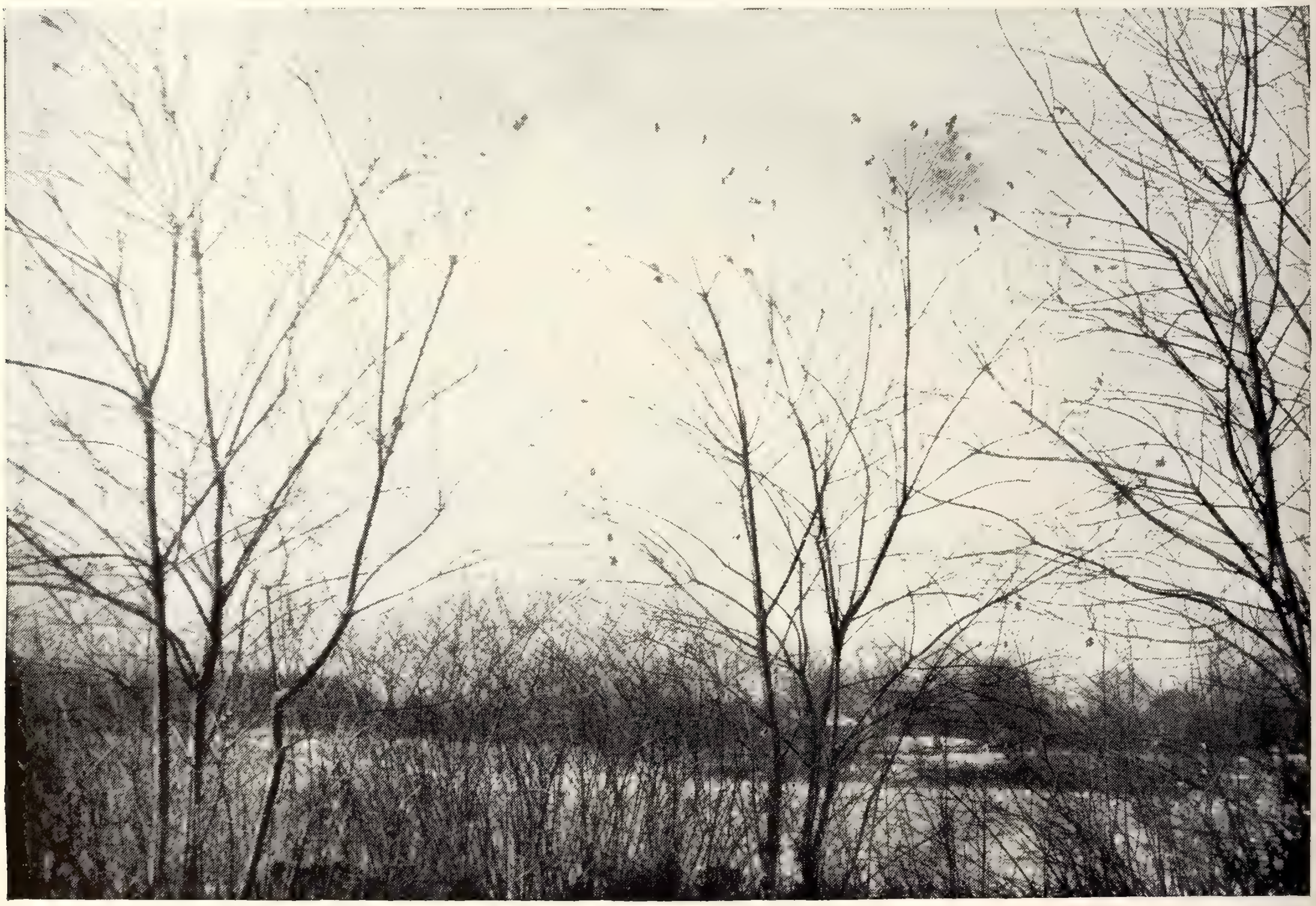
cherry, plum, and quince stock. It is held by importing nurserymen that particularly the cherry, plum, and quince stock is better grown abroad than at home. Nevertheless, until recently all such stock was home-grown, and probably the bulk of the apple-seedling stock is still home-grown. Admitting the necessity of the importation of some seedling stock, it is all the more desirable to have means to thoroughly inspect, and, if necessary, quarantine such stock.

The first concerted effort to obtain a national quarantine and inspection law



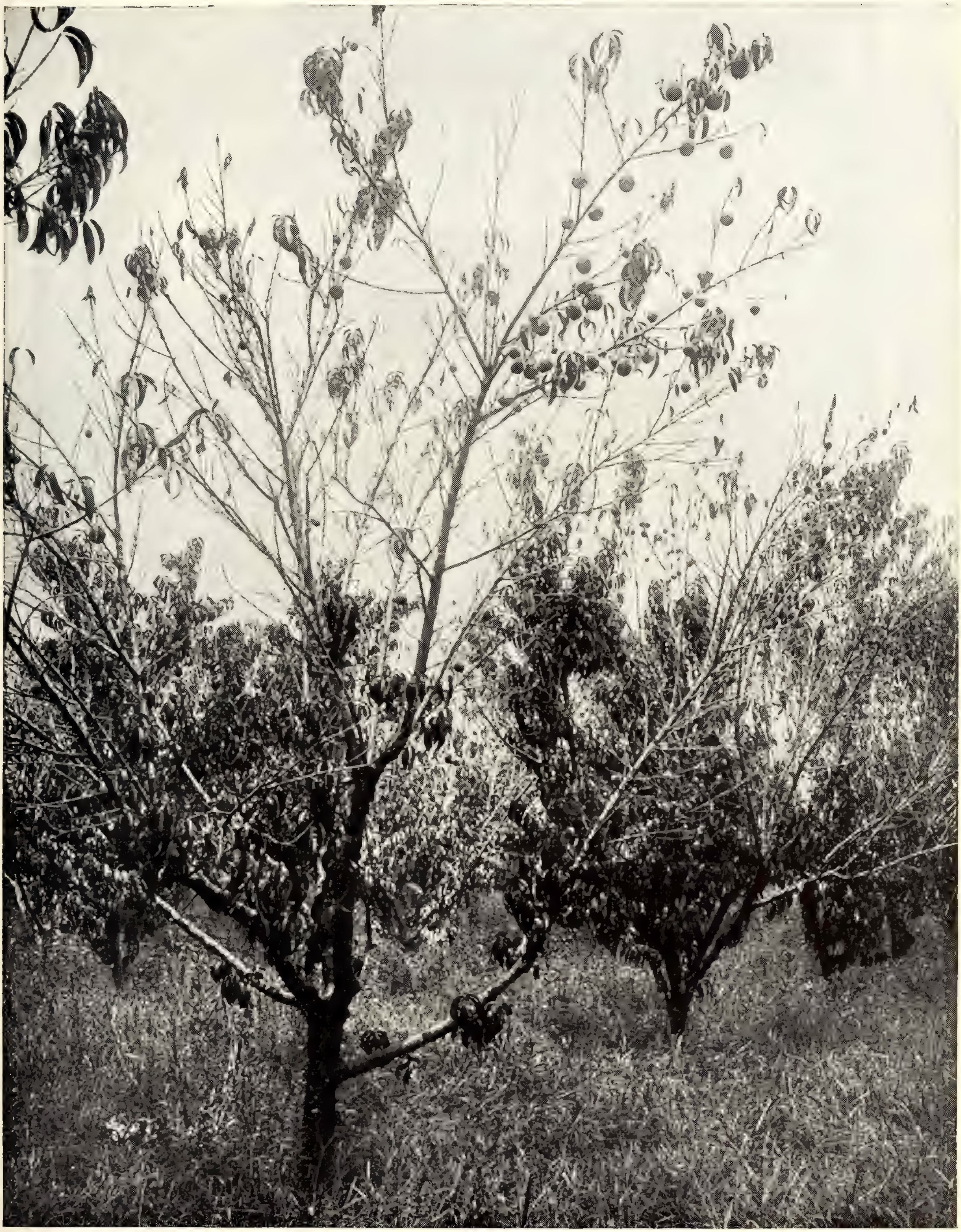
A HEDGE-ROW IN BELGIUM HEAVILY INFESTED WITH WINTER NESTS OF THE BROWN-TAIL MOTH, THE SMALL BLACK DOTS SEEN ON THE BRANCHES

This is a common condition of hedge rows and trees in Belgium. This photograph was taken within a few miles of the Holland border and within easy flight of the moths to certain large Dutch nurseries, which send immense quantities of stock to this country.



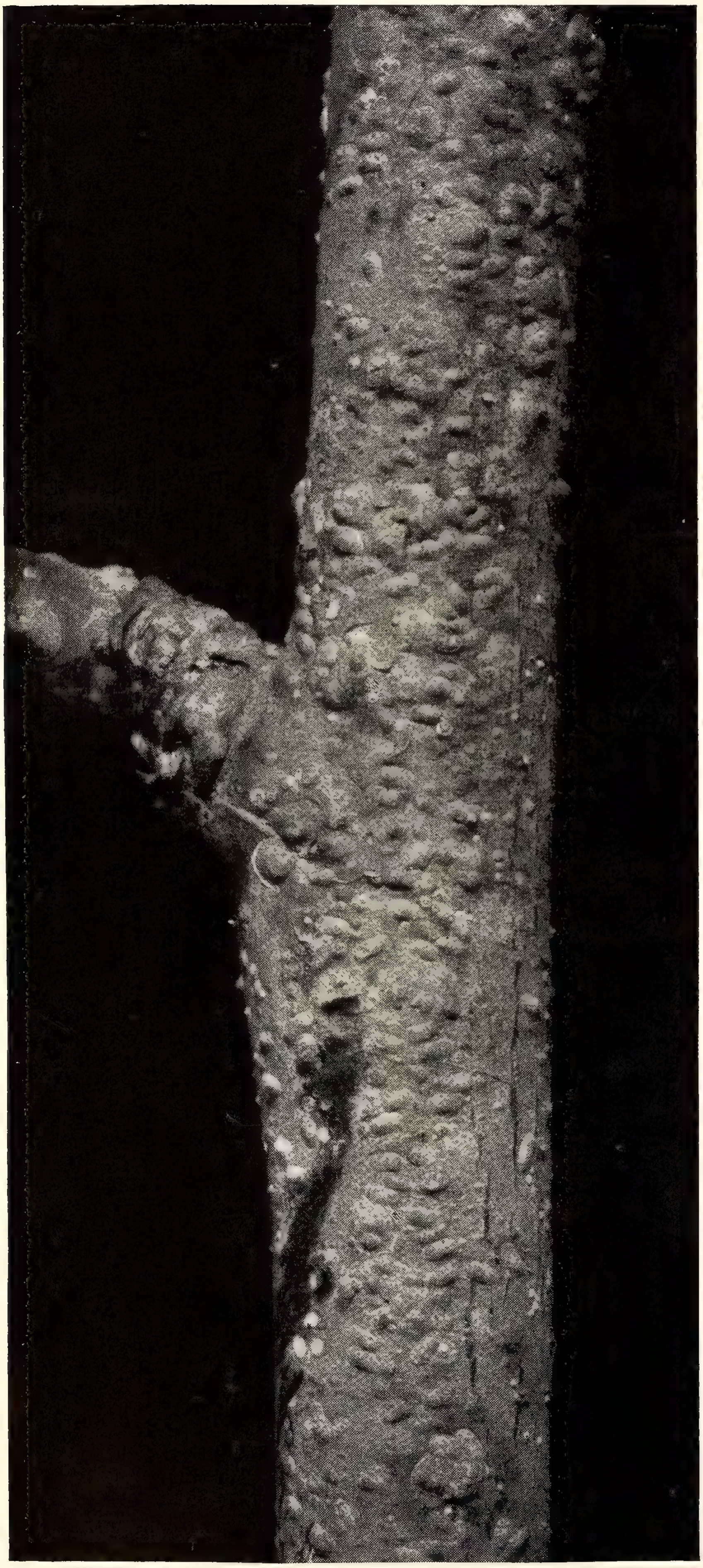
WINTER (1910) NESTS OF THE BROWN-TAIL MOTH IN AN INFESTED DISTRICT OF MASSACHUSETTS

These are easily recognizable objects and must be pruned off during winter and burned



THE EARLY STAGES OF THE SAN JOSÉ SCALE AT WORK IN A PEACH ORCHARD

Trees in full fruit dying. Peach, apple, and other trees are very quickly killed by this scale insect. The San José scale is probably the worst orchard pest that has ever come to America. It was evidently brought with ornamental stock from north China, its native home. It has already caused a loss of more than 50 million dollars, and more than 5 million dollars a year are now being spent for spraying trees to control it. This is an annual tax which does not include the damage to the trees and fruit, much exceeding the cost of spraying.



THE SAN JOSÉ SCALE AS IT APPEARS ON THE BARK

The small white dots are the young scale insects, and the larger shell-like objects are the full-grown scales. The insect lies beneath this shell-like covering, and is thus protected from parasitic enemies and from any except strong-killing washes.

was due to the introduction in the East on nursery stock of the San José scale in the early 90's. The failure to reach an agreement as to suitable legislation among the nurserymen, fruit-growers, and entomologists prevented anything coming from this effort, although several bills were introduced in Congress from time to time. In the meanwhile the San José scale became so widely distributed by transportation on infested nursery stock that quarantine against this insect was no longer practicable, and the country is now being taxed, and probably will be for all time, many millions of dollars annually in consequence of the absence of any law under which strong hold could have been taken of this danger at the outset.

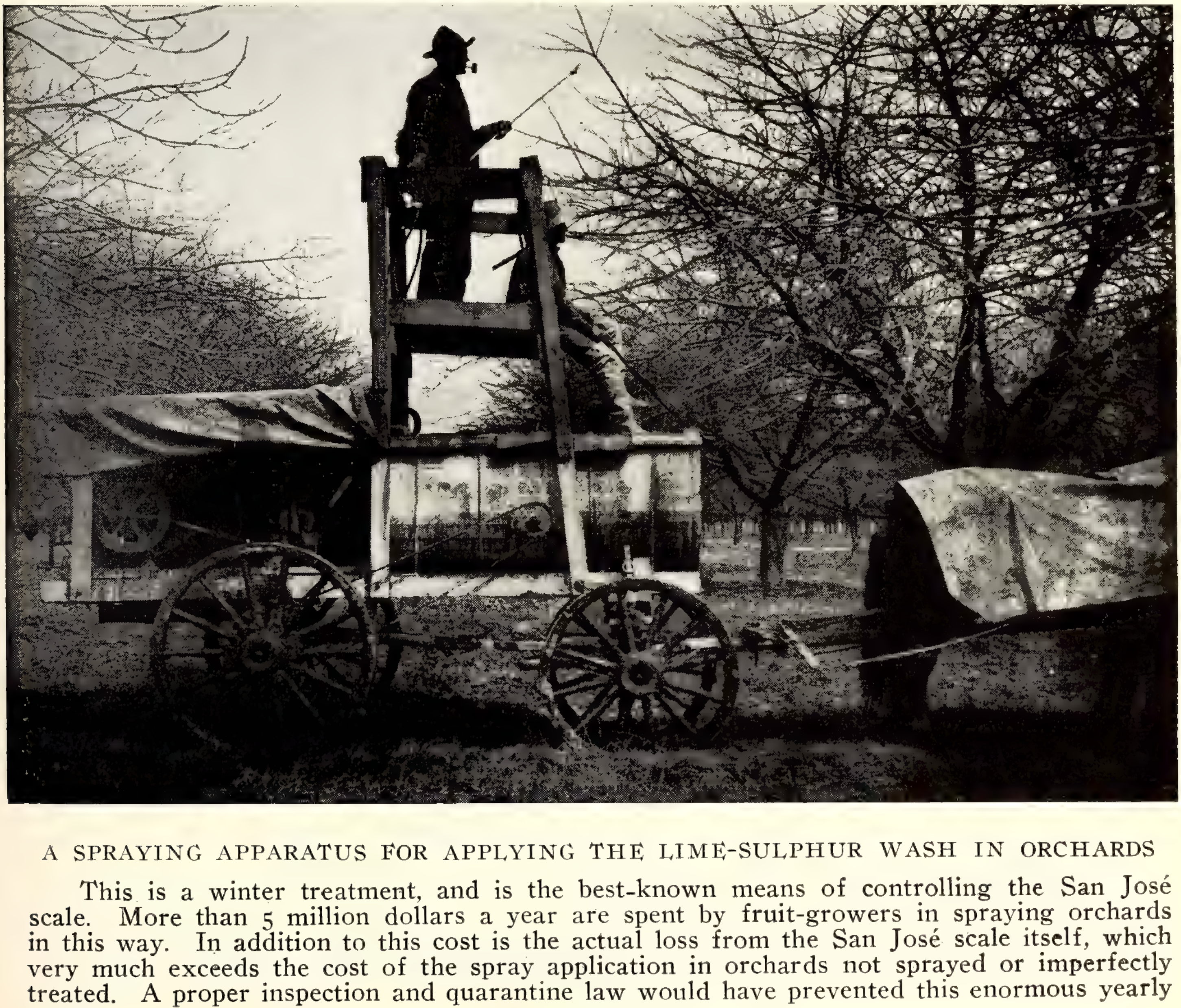
CRIMINAL CARELESSNESS

The present effort to secure legislation resulted from the discovery two years ago of the introduction of enormous quantities of brown-tail moth nests, full of hibernating larvæ, on seedling fruit stock, chiefly from northern France. With these were occasional egg-masses of the gypsy moth. During the years 1909 and 1910 such infested stock was sent to no less than 22 different States, covering the country from the Atlantic seaboard to the Rocky Mountains. During the first of these years no less than 7,000 winter nests of the brown-tail moth, containing approximately 2,800,000 larvæ, were found in shipments to New York State alone—seed material enough to infest the whole United States within a few years.

So far as possible, this stock sent to the different States has been examined and the brown-tail moth nests removed and de-

A PLANT FOR PREPARING LIME-SULPHUR WASH

This wash is prepared by cooking a lime and sulphur mixture with steam. The mixture is applied to trees in late winter, and is the best remedy so far found for the San José scale. All the large commercial orchards have their own plants for preparing this wash, which must be applied yearly to save the trees and fruit crop.

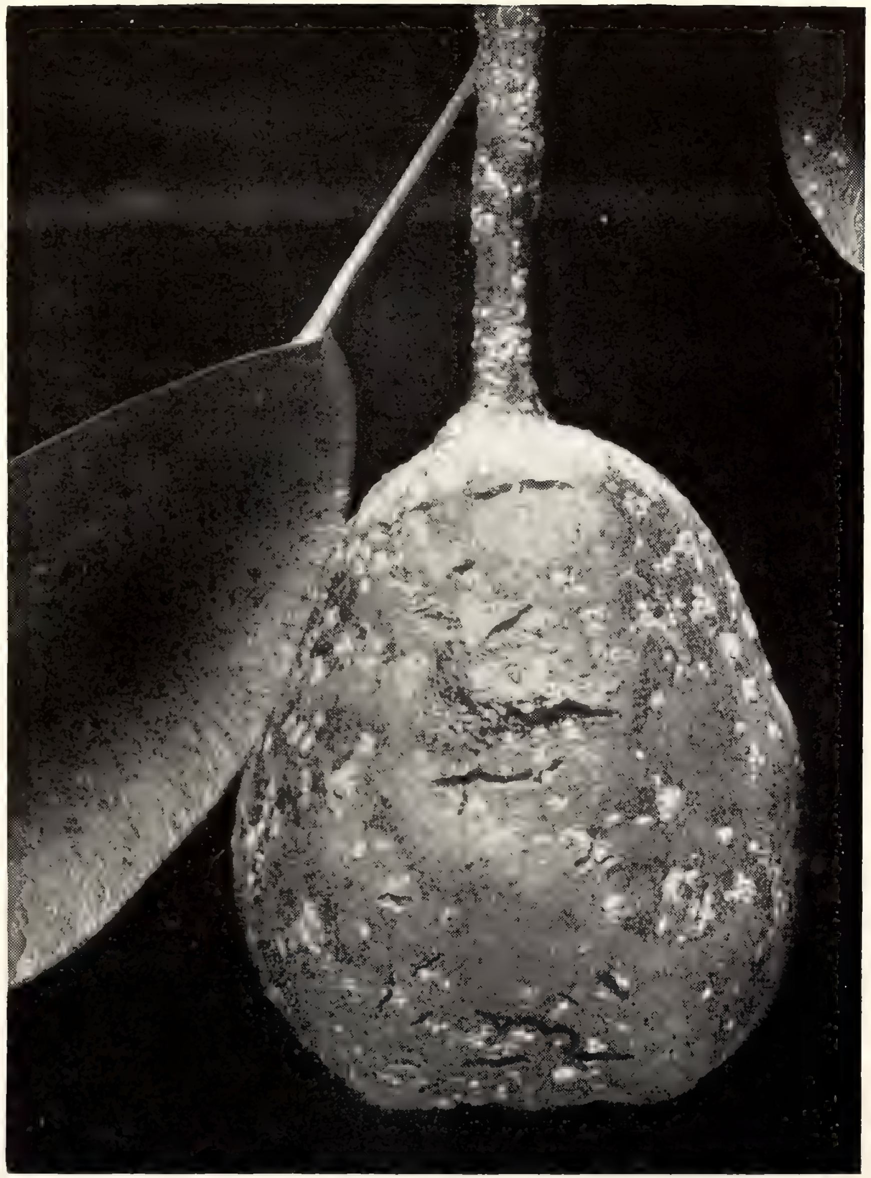


A SPRAYING APPARATUS FOR APPLYING THE LIME-SULPHUR WASH IN ORCHARDS

This is a winter treatment, and is the best-known means of controlling the San José scale. More than 5 million dollars a year are spent by fruit-growers in spraying orchards in this way. In addition to this cost is the actual loss from the San José scale itself, which very much exceeds the cost of the spray application in orchards not sprayed or imperfectly treated. A proper inspection and quarantine law would have prevented this enormous yearly loss.

CUTTING BACK AN APPLE TREE INFESTED WITH THE SAN JOSÉ SCALE PRELIMINARY TO SPRAYING

The cost of this work is very heavy in labor, and it means a loss of fruit for several years, as well as serious permanent injury to the tree



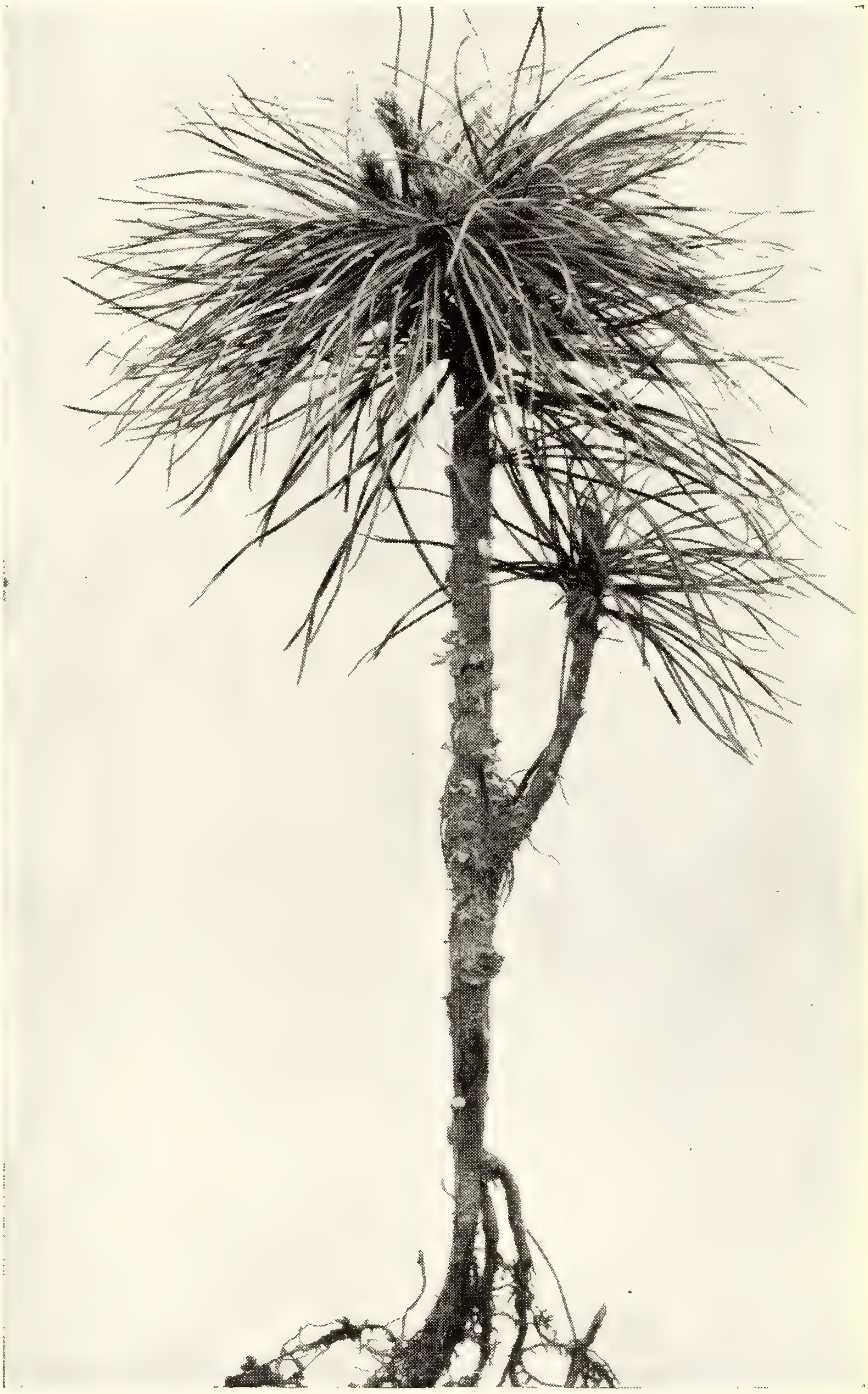
A PEAR INFESTED WITH THE SAN JOSÉ SCALE

The scale insect in sucking juices from the fruit or bark poisons the plant and causes a deformation of the fruit, as well as the killing of leaves and twigs, and ultimately the tree itself.

stroyed by State authorities; or, where these were not available, by the agents of the Bureau of Entomology of the United States Department of Agriculture. It is by no means certain, however, that all of the infested shipments have been located and freed.

It is scarcely necessary to comment on the tremendous danger to this country from the careless introduction and wide distribution of the brown-tail and gypsy moths with nursery stock. The cost of these insects in the New England States has already been referred to. The tax from these pests, should they gain a foothold throughout the country, is almost beyond estimate.

In addition to their great destructiveness to orchards and forests, the establishment of the brown-tail or gypsy moths in any suburban residential district means an enormous depreciation in property values, as is well illustrated about the city of Boston, and very notably lessens the attractiveness of coast or mountain summer-resort districts. The north-shore towns of Massachusetts and lower Maine resorts have already felt this influence, and for such regions as the Catskills or Adirondacks the establishment of these pests would mean an end of their more pleasing features. Control over such extended forested mountains would be a practical impossibility, and few would care to live amongst defoliated and caterpillar-infested trees, with the additional risk of dangerous and lasting poisoning from contact with the hairs or molted skins of the brown-tail moth.



A SEEDLING PINE

The white-pine blister rust, one of the most dangerous diseases of pine trees in Europe, is probably not yet established in America. Seedling pines affected by this disease are now being imported in enormous numbers. It was necessary to burn an entire shipment of 25,000 trees recently received in New York State. In its early stages this disease shows no outward sign, and hence can be excluded from this country only by prohibiting the importation of seedling pines from districts in Europe known to be infested. Its establishment in America would mean a tremendous loss to pine forests. The illustration is one of the diseased pine seedlings. The excrescences on the stem are the postules of the fungus.

THE BROWN-TAIL RASH

In addition to the great monetary loss, the brown-tail moth exercises a very deleterious effect on health. The hairs which cover the caterpillars of this moth are strongly nettling, and not only are they so from accidental contact with a caterpillar which may fall on clothes,

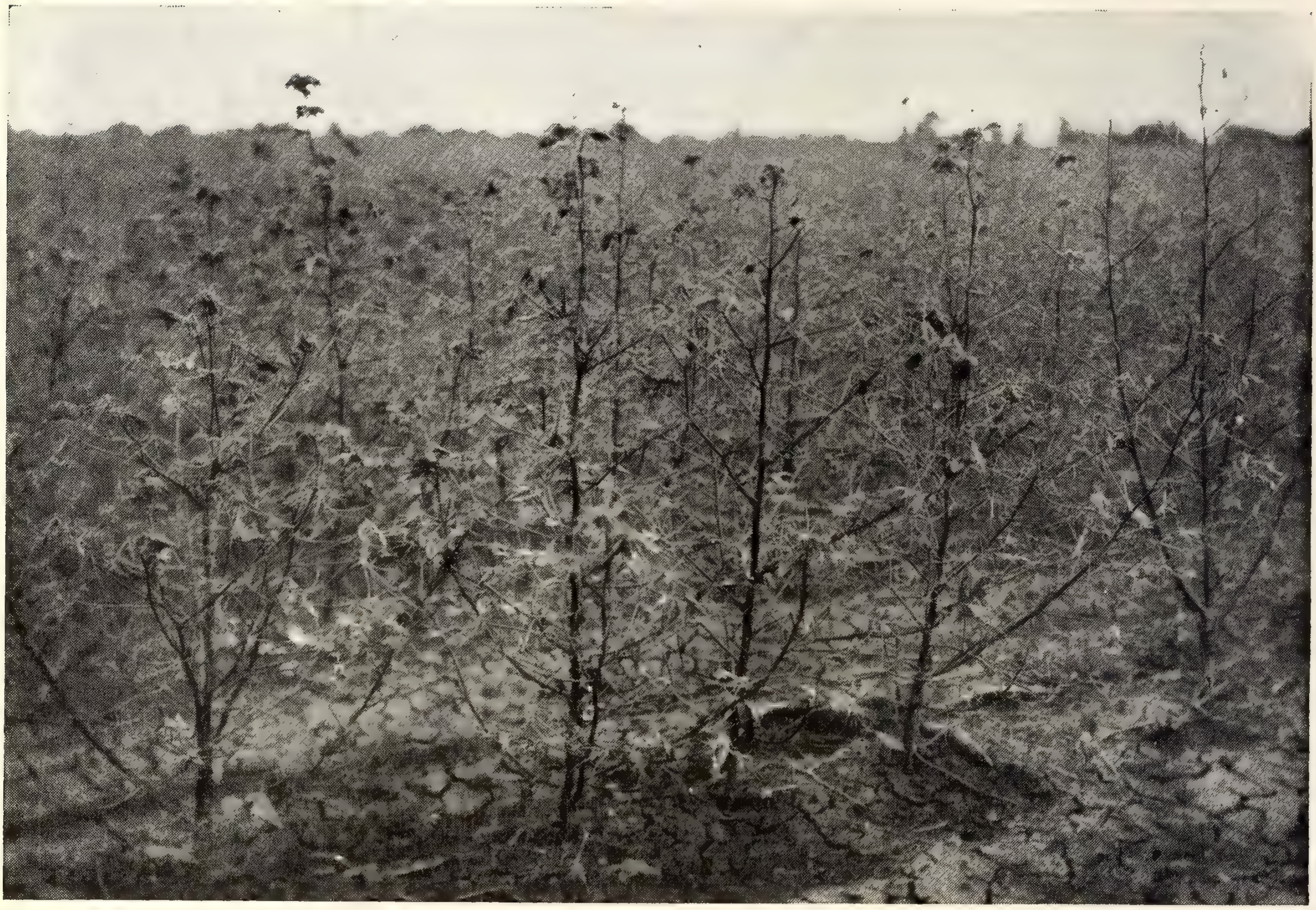


ILLUSTRATION SHOWING A COTTON FIELD PLANTED LATE AND YIELDING NOTHING, BECAUSE OF THE RAVAGES OF THE BOLL WEEVIL

The cotton-boll weevil, an immigrant from Mexico, first invaded Texas and is now extending eastward as far as Louisiana and Mississippi. It causes a loss of cotton to the value of more than 20 million dollars every year. The plants are healthy, but have no bolls or cotton; the weevil has taken it all. The field shown in the illustration on the next page contains a normal cotton crop ready for harvest. This field has been protected from the boll weevil by methods determined by the work of the Bureau of Entomology, U. S. Department of Agriculture.

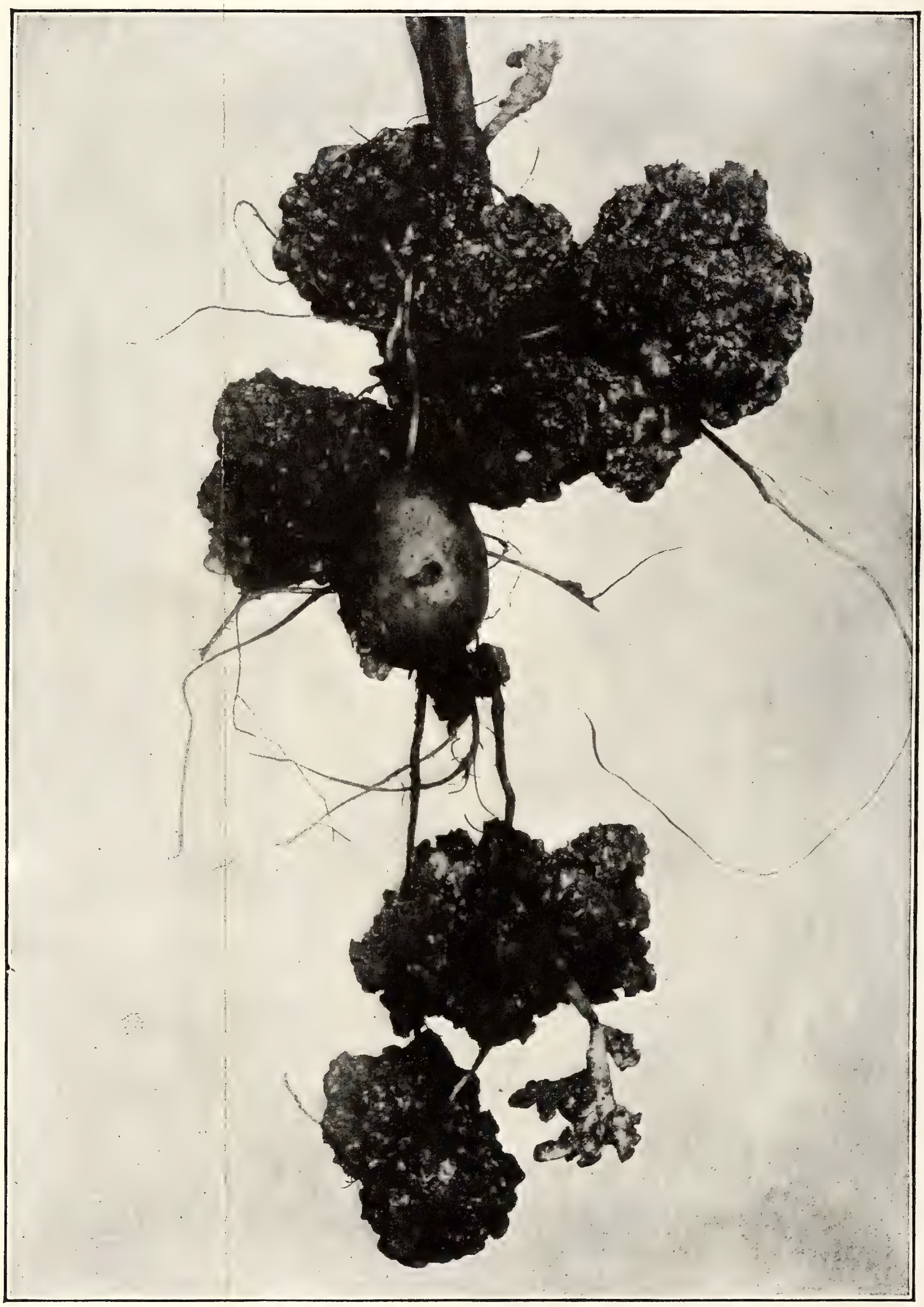
face, neck, or hands from an infested tree, but also from the myriads of hairs which are shed by these caterpillars when they transform to the chrysalis state. The hairs are carried about by winds and find lodgment on clothing, or collect on one's face, neck, or hands, and frequently cause very disagreeable and extensive nettling, the effect of which may last for months. Breathed into the lungs, they may cause inflammation and become productive of tuberculosis.

The brown-tail rash is well known throughout the regions infested in New England, and thousands have suffered from it. All of the assistants who have been connected with the government work in the New England States with these pests have been seriously poisoned, and two of them have had to give up their work and go to the Southwest to attempt to recover from the pulmonary troubles superinduced by the irritating hairs of the brown-tail moth.

This insect is therefore a most undesirable neighbor, even if it were not responsible for great injury to orchards and ornamental trees. When it is realized that the brown-tail moth has already been distributed on imported nursery stock throughout 22 States during the last two years, the danger to the whole country is sufficiently apparent.

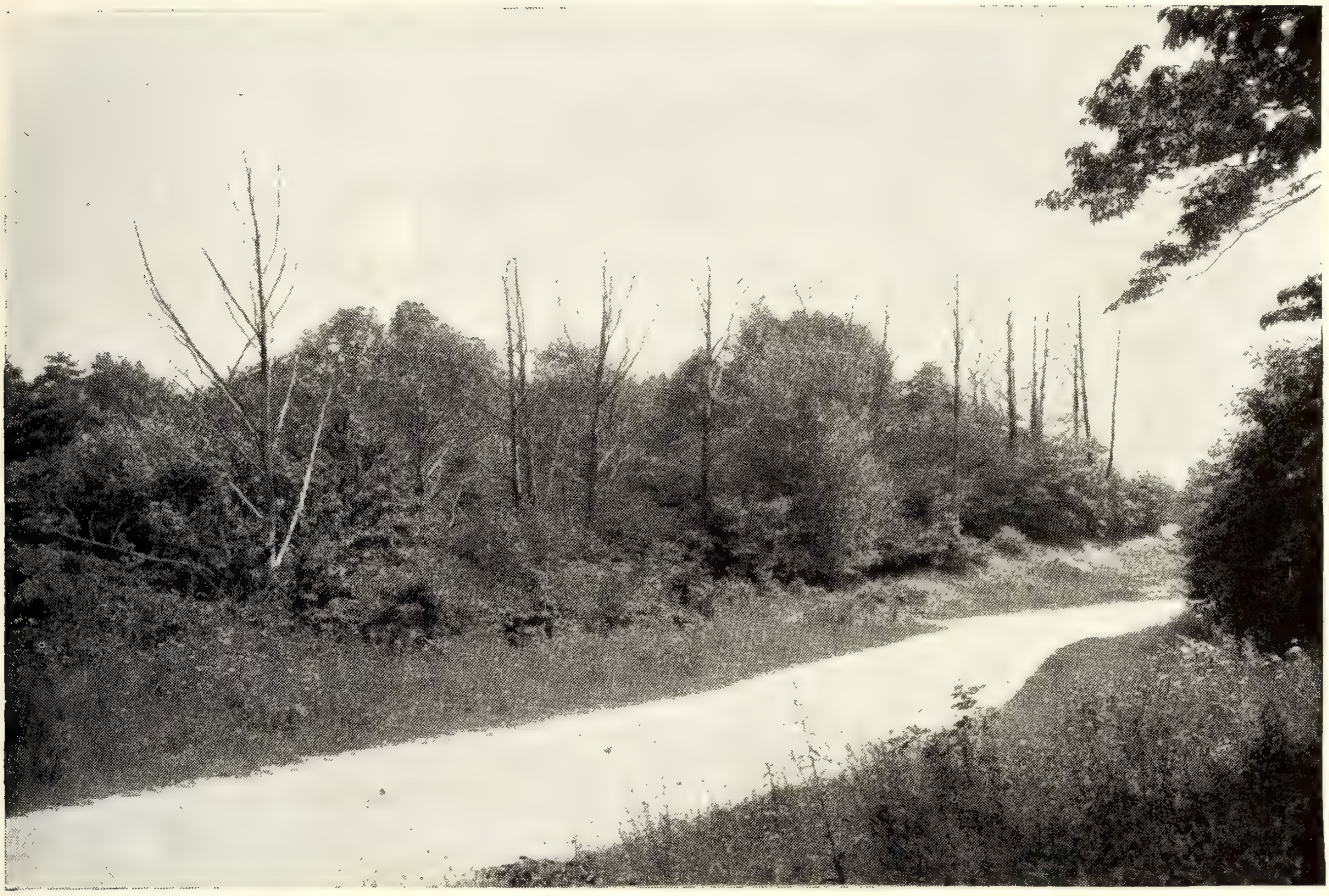
In view of this special danger—which after all is only a continuation of the dangers and experiences to which this

This illustration shows a field on the opposite side of turn-row on the same plantation as in preceding picture, planted and treated in accordance with directions of Bureau of Entomology and yielding three-quarters bale per acre



POTATO PLANT ATTACKED BY WART DISEASE

This disease has stopped potato culture in Europe wherever it has appeared, and is now established in Newfoundland, and diseased potatoes are now coming into the United States, threatening to establish the disease here. This disease, once in the soil, stops potato culture. Its introduction into the United States would mean a loss of millions of dollars annually.



A VIEW IN FOREST PARK, BROOKLYN

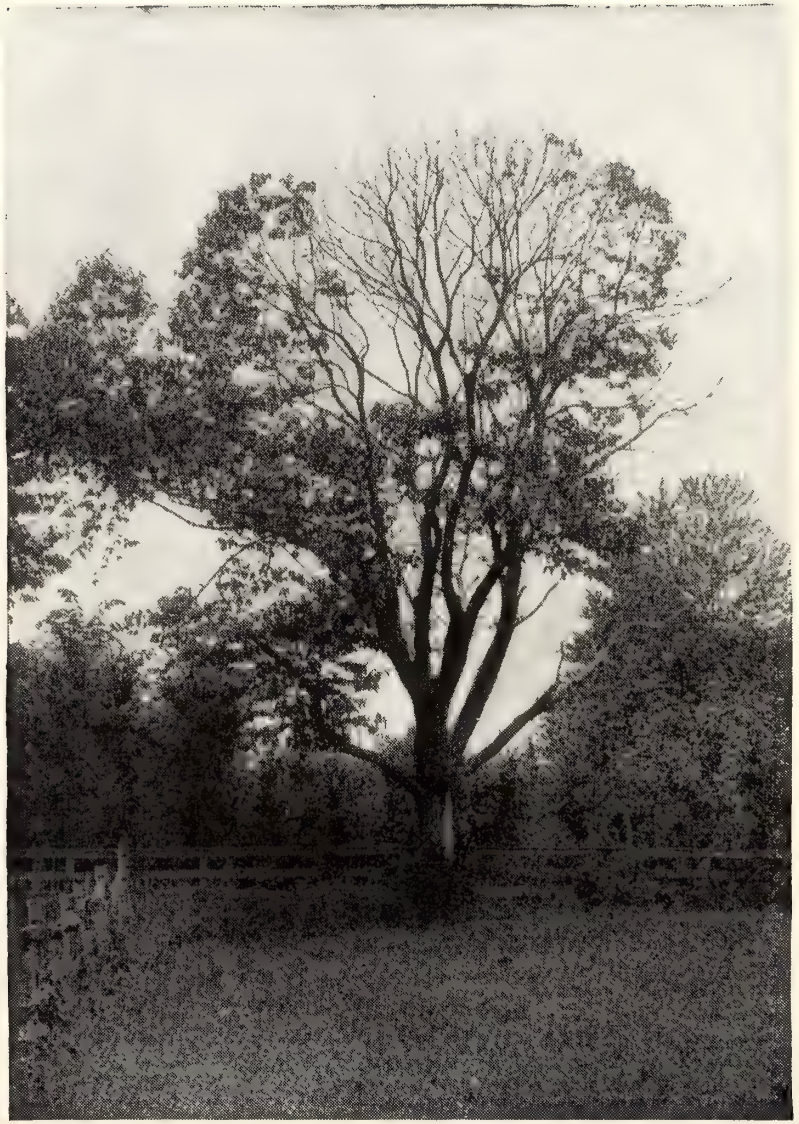
Seventeen thousand chestnut trees have been killed in this park by the chestnut-bark disease, despite every effort made to save them. Photo by Haven Metcalf

country has been long subjected—a new bill was drafted and submitted to Congress for action, the passage of which would give this country great protection. It is a compromise measure—compromise in the sense that efforts have been made to meet the objections of these importing nurserymen. Its enactment will undoubtedly give this country great protection, but not absolute protection, for the simple reason that no inspection or disinfection can be guaranteed to be perfect in its results; and, in addition, there is always the risk of carelessness or venality on the part of inspectors. The bill provides for the introduction of foreign plants by permit only, for the inspection and disinfection of such stock at point of destination in this country, and, in case of need, the quarantining of foreign districts which may contain pests or diseases not possible to be excluded by inspection and disinfection.

Absolute prohibition of entry of nursery stock, except for the introduction of plants new to the United States, through the agency of the United States Department of Agriculture, is the only perfect means of preventing ultimate entrance of dangerous insects, and this is the course which has been adopted, as already indicated, by most of the foreign powers in relation to their own territory. The danger and amount of damage possible from these new pests justify the recommendation of such prohibition, especially in view of the small value of imported nursery stock in comparison with the risk and the fact that most of it at least can be just as well produced at home as abroad.

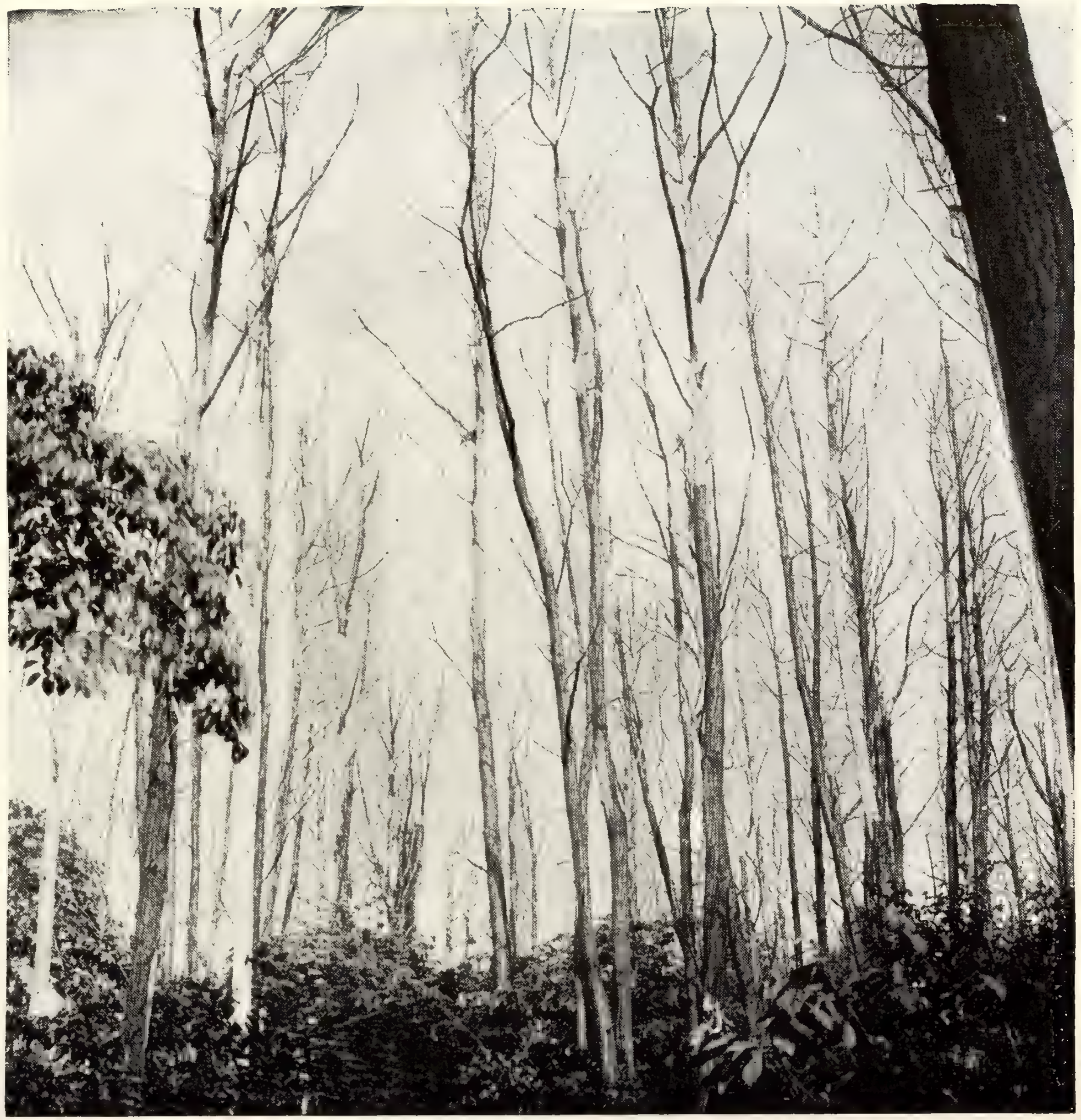
The State of California for the last 20 years has enforced a quarantine at the port of San Francisco, which is the only port in this country so guarded. During these 20 years a great many dangerous insects and diseases have been detected and stopped at this port, to the enormous gain of the fruit interests of California, and, indirectly, of the whole country.

Some of our more recently developed fruit districts in the great Northwest and



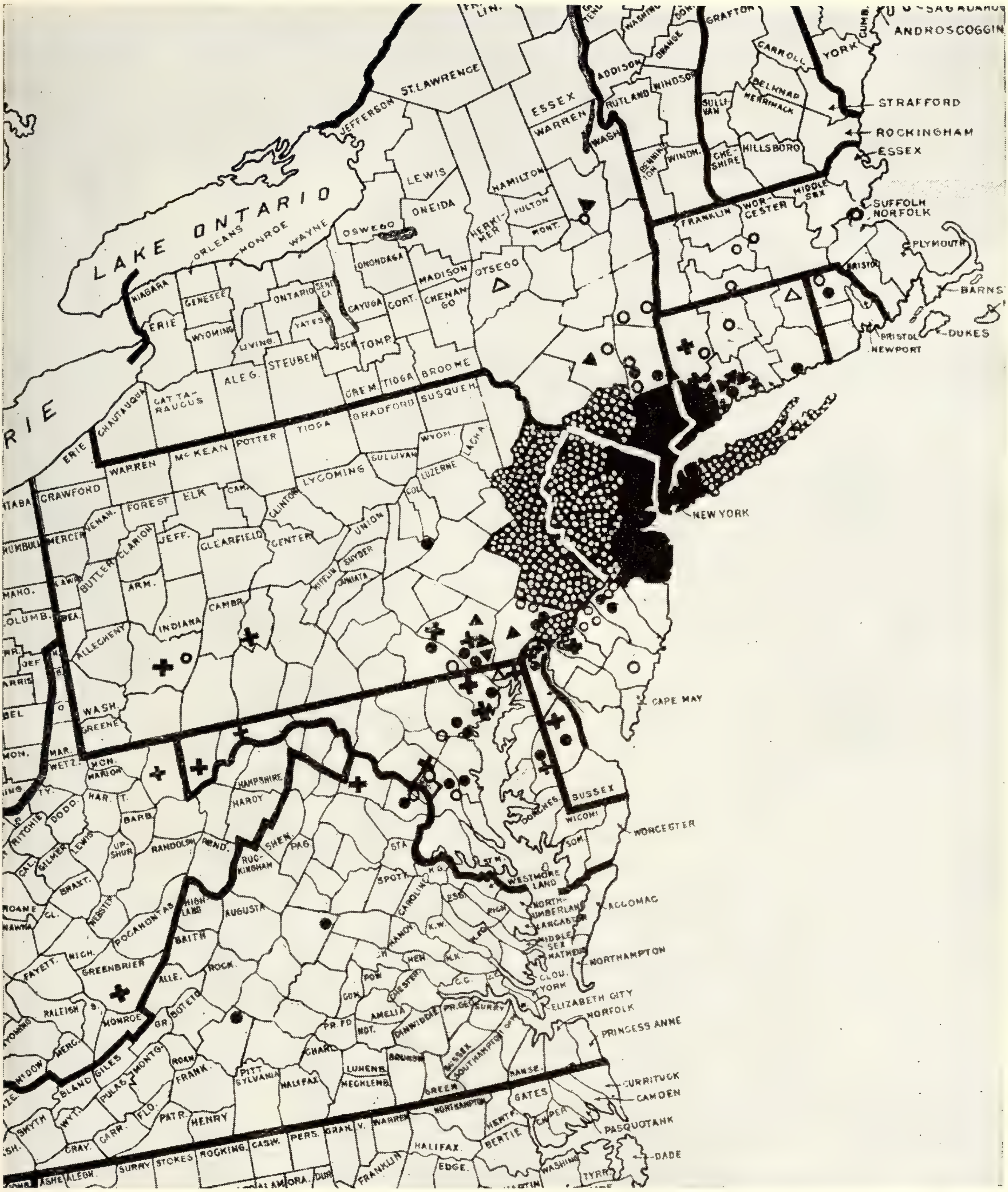
ORNAMENTAL CHESTNUT TREES DYING OF THE BARK DISEASE

Trees of this size are frequently killed in one season. Photos by Haven Metcalf



DEAD CHESTNUT TREES IN FORESTS ON LONG ISLAND

This disease is carried by birds, wind, and insects, and no attacked tree ever recovers. Trees 100 years old may withstand the disease three or four years. Young trees succumb in a single year.



MAP SHOWING DISTRIBUTION OF THE CHESTNUT-BARK DISEASE (*Diaperthe parasitica* Murr.) IN DECEMBER, 1910

It was probably imported with chestnut trees from Japan. First observed in the parks of New York City in 1904, it has since rapidly spread, and now covers much of adjacent territory in lower New York, Connecticut, Long Island, New Jersey, and Pennsylvania, with widely scattered points of infestation. It is estimated that the loss in and about the city of New York is now between 5 and 10 million dollars, and the loss throughout the areas now infested is fully 100 million dollars. There is a prospective loss in Pennsylvania of fully 50 million dollars, and the entire chestnut timber of America seems to be doomed. All this might have been saved with proper quarantine laws.

EXPLANATION OF SYMBOLS

Black area. Complete infection; trees mostly dead. *Spotted area.* General infection. *Black dots.* Infection reported by specimens or observed prior to 1909. *Black crosses.* Infection reported by specimens or observed in 1909. *Black triangles.* Infection reported on reliable authority in 1909. *Circles.* Infection reported by specimens or observed in 1910. *Hollow triangles.* Infection reported on reliable authority in 1910.

some of the more newly opened Canadian provinces, profiting by past experience, have established protective quarantine regulations, which should for a long period give these regions a tremendous advantage over older fruit centers in lessening the cost of production.

It is useless now to dwell on what could have been saved to the agriculture and natural-forest resources of this continent if our forefathers had been wise enough to have early established and intelligently enforced inspection and quarantine regulations against the Old World to exclude plant diseases and insect enemies. That would have been conservation in its most practical form. The past cannot be remedied, but the future can be safeguarded, and that is the present opportunity. The first step towards securing the desired legislation is to arouse a public realization of the need. The moment this need becomes generally felt, the legislation will be forthcoming.

OUR GREATEST TRAVELERS

Birds that Fly from Pole to Pole and Shun the Darkness: Birds that Make 2,500 Miles in a Single Flight

By Wells W. Cooke

Of the Biological Survey, U. S. Department of Agriculture

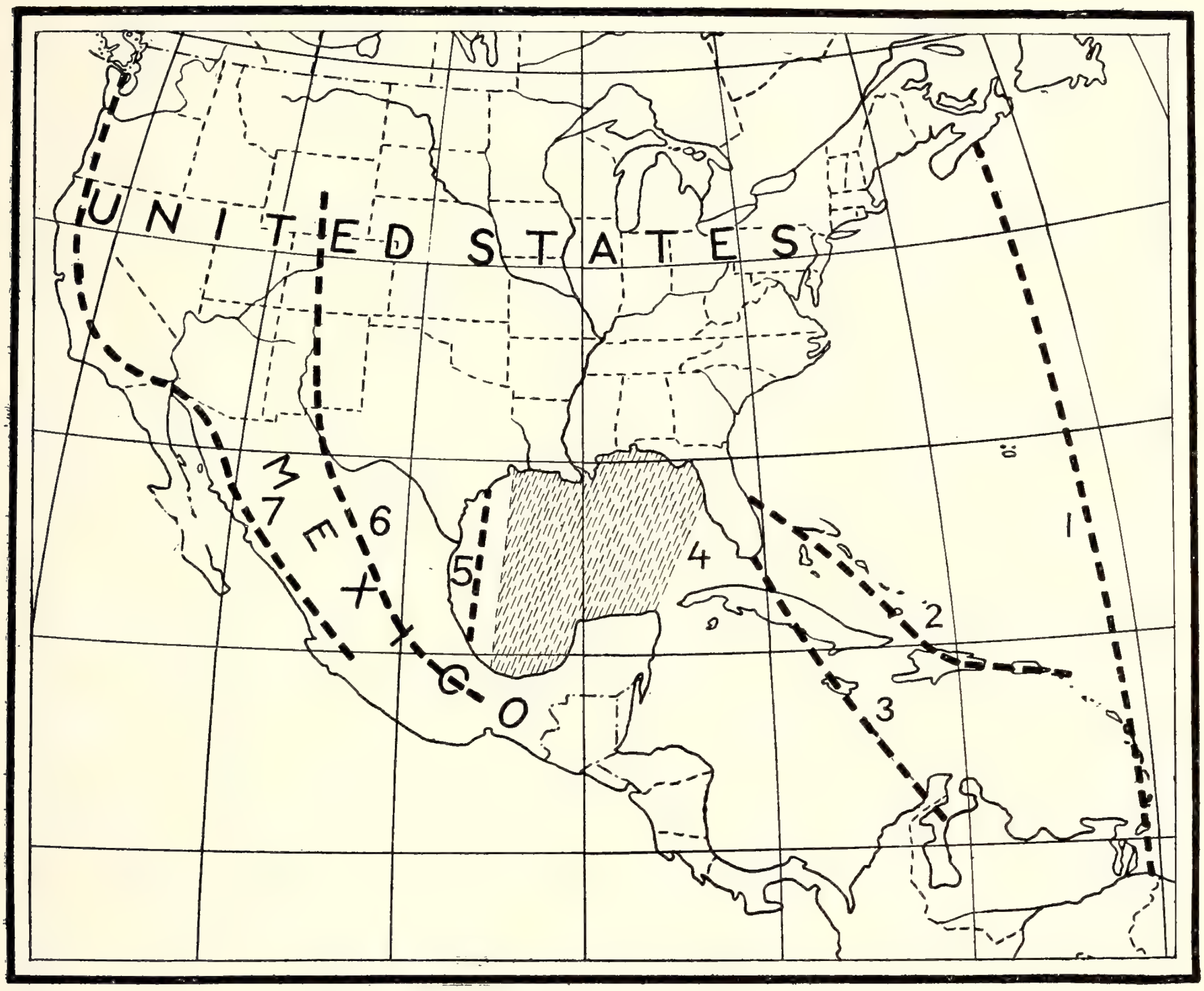
THE migration of birds has long been considered an unfathomable mystery, but late investigations have furnished abundant data on the when and where of migration and solved many of its puzzles. The Bureau of Biologic Survey of the United States Department of Agriculture has collected much information on the migration of North American birds, and this article is an attempt to put in popular form some of the data that have already appeared in the more technical bulletins and reports. No correct understanding of bird migration is possible until it is considered as a voluntary evolution. All migratory movements must have begun with changes of location, which were only very slight.

From this short migration, benefit accrued to individuals or to their posterity. Migration became a fixed habit, and the distance covered gradually—very gradually—increased as each succeeding extension proved advantageous. It is not to be supposed that every attempted extension was a success; in fact, it is more probable that only a small part of the experimental pioneering routes were permanently adopted.

Moreover, it must be borne in mind that the time occupied in the establishment of present migration habits and routes was measured in geologic ages, and there is no reason to suppose that changes took place during these ages any faster than they do now.

It is about a hundred years since the first reliable notes on migration in the United States were recorded, and this period has proven too short to show any perceptible difference in its time, direction, or speed. It can be affirmed, then, that the migration routes of today are the results of innumerable experiments as to the best way to travel from the winter to the summer home and return.

It can also be said that food supplies en route have been the determining factor in the choice of one course in prefer-



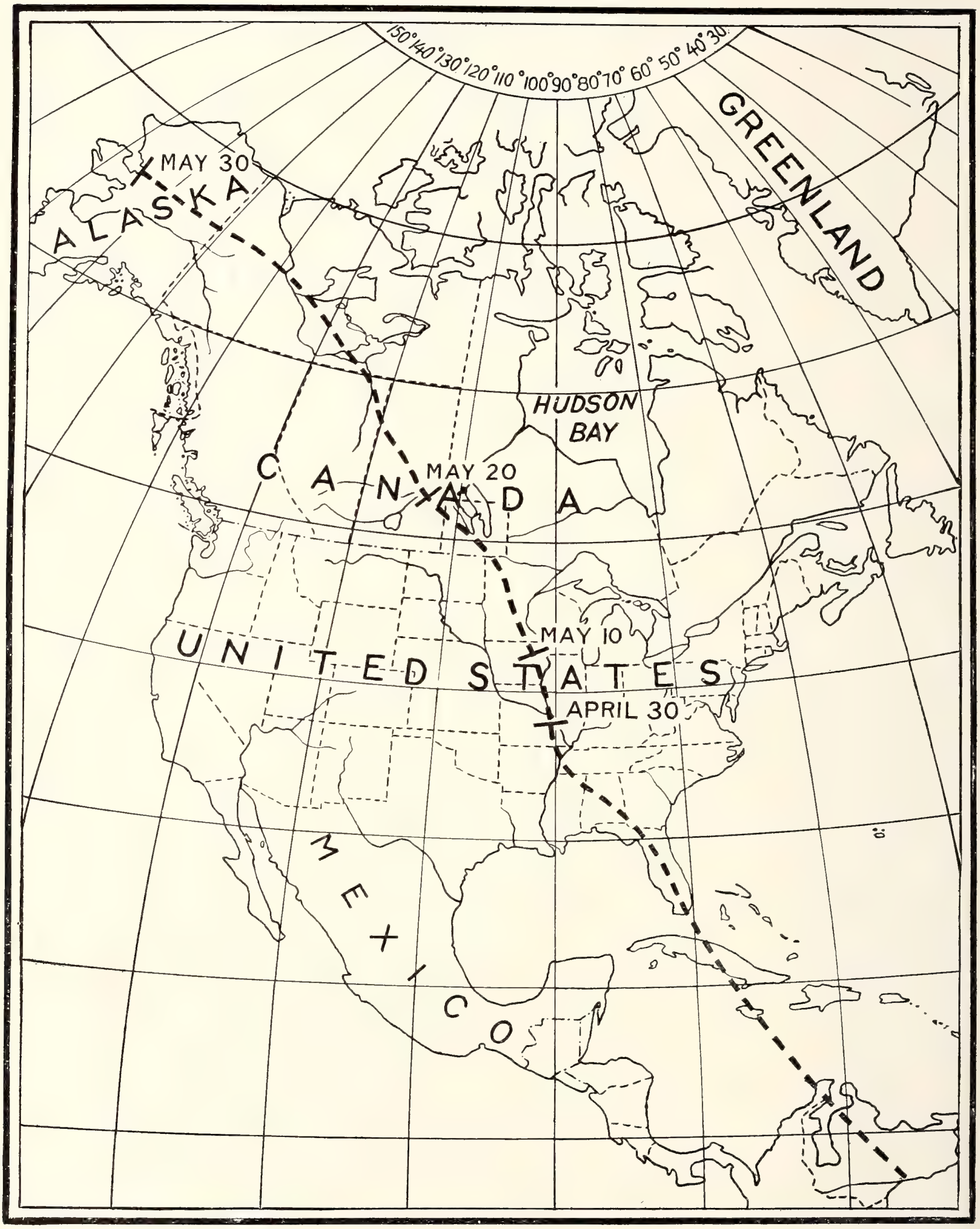
MAP SHOWING THE PRINCIPAL ROUTES USED BY BIRDS IN THEIR MIGRATIONS BETWEEN NORTH AND SOUTH AMERICA

ence to another, and not the distance from one food base to the next. The location of plenty of suitable provender having been ascertained, the birds pay no attention to the length of the single flight required to reach it.

PRINCIPAL MIGRATION ROUTES OF NORTH AMERICA

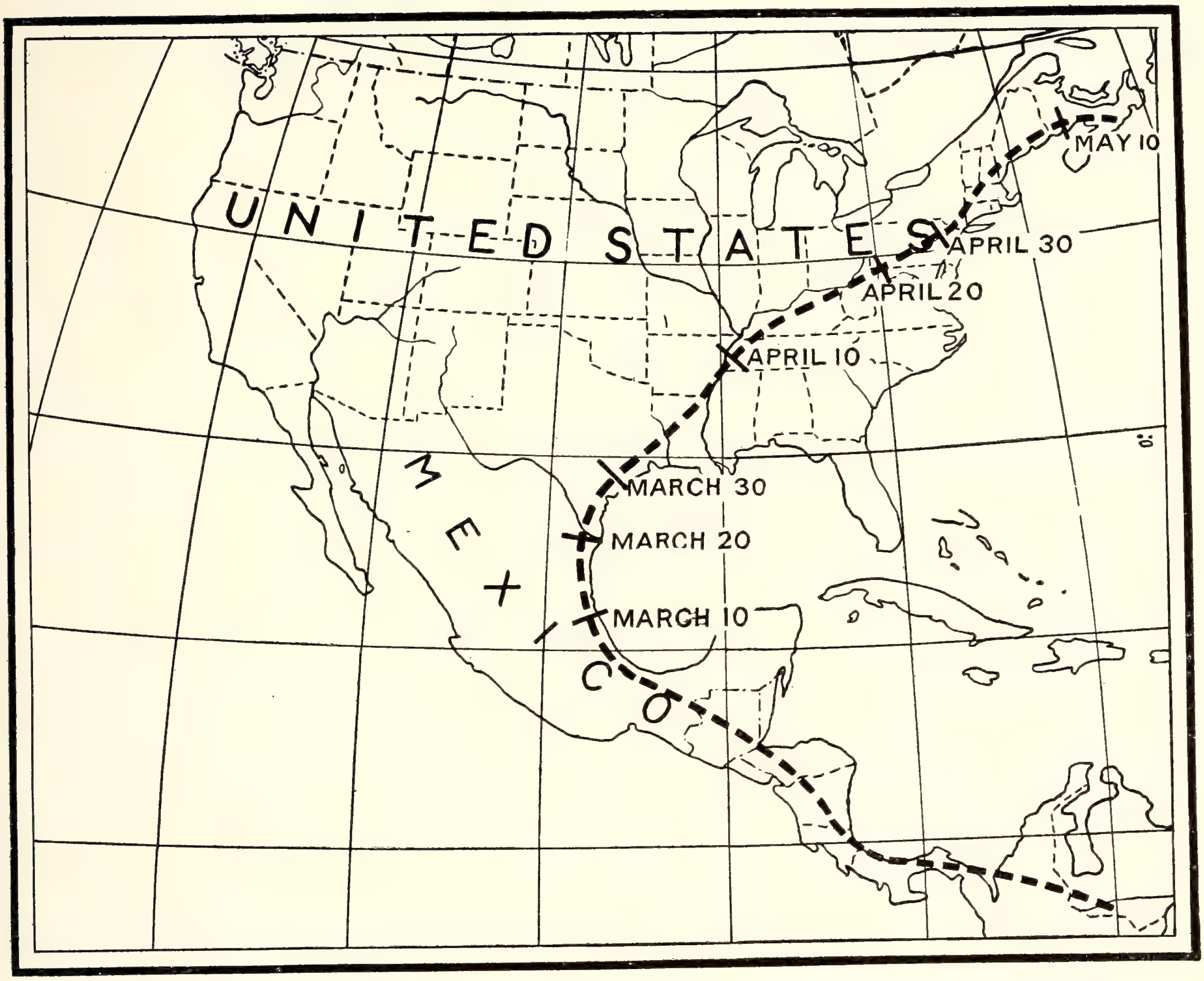
The shape of the land areas in the northern half of the Western Hemisphere has tended to great variations in migratory movements. If the whole area from Brazil to Canada were a plain with the general characteristics of the middle section of the Mississippi Valley, the study of bird migration would lose much of its fascination. There would be a simple rhythmical swinging of the migration pendulum back and forth spring and fall. But a large part of the space between Brazil and Canada is occupied by the Gulf of Mexico, the Caribbean Sea, and parts of the Atlantic Ocean, all devoid of sustenance for land birds. The two areas of abundant food supplies are North America and northern South America, separated by the comparatively small land areas of Mexico and Central America, the islands of the West Indies, and the great stretches of foodless waters.

The different courses taken by the birds to get around or over this intervening inhospitable region are almost as numerous as the bird families that traverse them, and only some of the more important ones are shown on the accompanying map (page 347). The routes are numbered from the east westward, the middle one, No. 4, being by far the most important. In general it may be said to extend from northwestern Florida and western Louisiana across the Gulf of Mexico to the southern coast of the Gulf (Yucatan to Vera Cruz), and



MIGRATION ROUTE OF THE BLACK-POLL WARBLERS THAT NEST IN ALASKA

This bird winters in South America alongside the cliff swallow, but in summer seems to try and get as far as possible from its winter neighbor. Note how its northward route diverges from the northward flight of the cliff swallow, shown on the map on the opposite page. It travels at night, often flying several hundred miles in the darkness (see pages 349, 351, and 363).



MIGRATION ROUTE OF THE CLIFF SWALLOWS THAT NEST IN NOVA SCOTIA (SEE PAGES 348, 351, AND 365)

The swallow, unlike the warbler, travels by day

thence by land through Central America to South America. Probably more individuals follow this route than all the other routes combined.

The birds east of the Alleghany Mountains move southwest in the fall approximately parallel with the seacoast, and most keep this same direction across the Gulf to eastern Mexico. The birds of the central Mississippi Valley go southward to and over the Gulf. The birds between the Missouri River and the edge of the plains, and those of Canada east of the Rocky Mountains, move southeastward and south until they join the others in their passage of the Gulf.

In other words, the great majority of North American birds bound for a winter's sojourn in Central or South America elect a short cut across the Gulf of Mexico in preference to a longer land journey by way of Florida or Texas. In fact, millions of them cross the Gulf at its widest part, which necessitates a single flight of 500 to 700 miles.

The peninsula of Florida extends far to the south, and the great island of Cuba forms a convenient stepping-stone between its coast-line and Yucatan. A bird taking this highway would avoid any long single flight; yet, with the exception of a few day-migrating swallows, no bird is known to follow this route. A probable explanation is that southern Florida has vastly less bird food per square mile than the country to the northward, and the birds prefer a single long flight with abundant rations to a series of shorter flights on scantier fare.

Migration route No. 3, which is by way of Cuba and Jamaica, offers a much shorter journey to South America, but it is traversed by only a few species. It is popular as far as Cuba with some 60 species, of whom great numbers spend the winter on the island; about 30 of these species have a small contingent who pass on to make Jamaica their winter resort; but scarcely more than 10 species try the final long flight across the Caribbean Sea to South America. Among these are one species each of six widely differing families—the bank swallow, gray kingbird, Florida nighthawk, Alice thrush, black-poll warbler, and bobolink. The other members of those families employ entirely different migration routes.

It is not possible to ascertain whether these travelers on the so-called "bobolink route" represent adventurous species that are seeking to improve on the roundabout course through Mexico, or old fogies who hold to the way of their forefathers long after their brethren have proven to their own satisfaction the superior advantages of the more western route.

The next route to the eastward, No. 2, traverses the chain of islands that extend from Florida to South America. This, too, is considerably shorter than the Florida-Yucatan route, and land can always be kept in sight; yet this line also is discredited. A few individuals of about 25 species follow it as far as Porto Rico, and only 6 of these continue to the South American coast, and these last in such diminished numbers as to form an insignificant fraction of the winter visitants in that region.

The explanation, of course, lies in the question of food. The combined area of all the West India islands east of Porto Rico is so small that it could not furnish subsistence for even one per cent of the myriads of birds which throng the main migration route across the Gulf.

To the westward the short route, No. 5, stretches a few hundred miles from the coast of Texas to northern Vera Cruz. It is adopted by a few Kentucky warblers, worm-eating warblers, golden-wing warblers, and some others, who seek in this way to avoid a slow journey by land across a region scantily supplied with moist woodlands.

Still farther west, routes 6 and 7 represent the land journeys of those birds from the western United States who winter in Mexico and Central America. Their trips are comparatively short; most of them are content to stop when they have reached the middle districts of Mexico, and only a few pass east of the southern part of that country.

Route No. 1 remains to be noticed. It extends in an approximately north-and-south line from Nova Scotia to the Lesser Antilles and the northern coast of South America. Though more than a thousand miles shorter than the main migration route, it is not employed by any land bird. But it is a favorite fall route for thousands of water birds, and as such will be referred to again more in detail.

It must not be considered that these routes as outlined on the map represent distinctly segregated pathways with clearly defined borders. On the contrary, they are merely convenient subdivisions of the one great flightway which extends from North to South America. There is probably no single mile in the whole line between northern Mexico and the Lesser Antilles which is not crossed each fall by migrating birds. What is meant is that the great bulk of the birds, both as to species and number of individuals, cross the Gulf to eastern Mexico, while to the eastward their numbers steadily diminish.

LIGHT-HOUSES LURE THOUSANDS OF BIRDS TO DESTRUCTION

It is not to be supposed that these long flights over the waters can occur without many casualties, and not the smallest of the perils arises from the beacons which man has erected along the coast to insure his own safety. "Last night I could have filled a mail-sack with the bodies of little warblers which killed themselves striking against my light," wrote the keeper of Fowey Rocks light-house, in southern Florida.

Nor was this an unusual tragedy. Every spring the lights along the coast lure to destruction myriads of birds who are en route from their winter homes in the South to their summer nesting places in the North. Every fall a still greater death-toll is exacted when the return journey is made.

Light-houses are scattered every few miles along the more than 3,000 miles of our coast-line, but two light-houses—Fowey Rocks and Sombrero Key—are responsible for far more bird tragedies than any others. The reason is twofold: their geographic position and the character of their lights. Both are situated at the southern end of Florida, where countless thousands of birds pass each year to and from Cuba. Both lights are of the first magnitude, on towers 100-140 feet high, and Fowey Rocks has a fixed white light, the deadliest of all.

A red light or a rapidly flashing one repels the birds, but a steady white light piercing the storm and fog proves irresistible. From whatever direction they approach they veer to windward, and then, flying against the wind, seek the object of their infatuation. The larger part do not strike with sufficient force to injure themselves, but, like great moths, they flutter in and out of the light's rays, and finally settle on the platform or framework to await the abatement of the storm or the coming of sufficient daylight to enable them once more to orient themselves.

NEIGHBORS IN WINTER AND REMOTE STRANGERS IN SUMMER

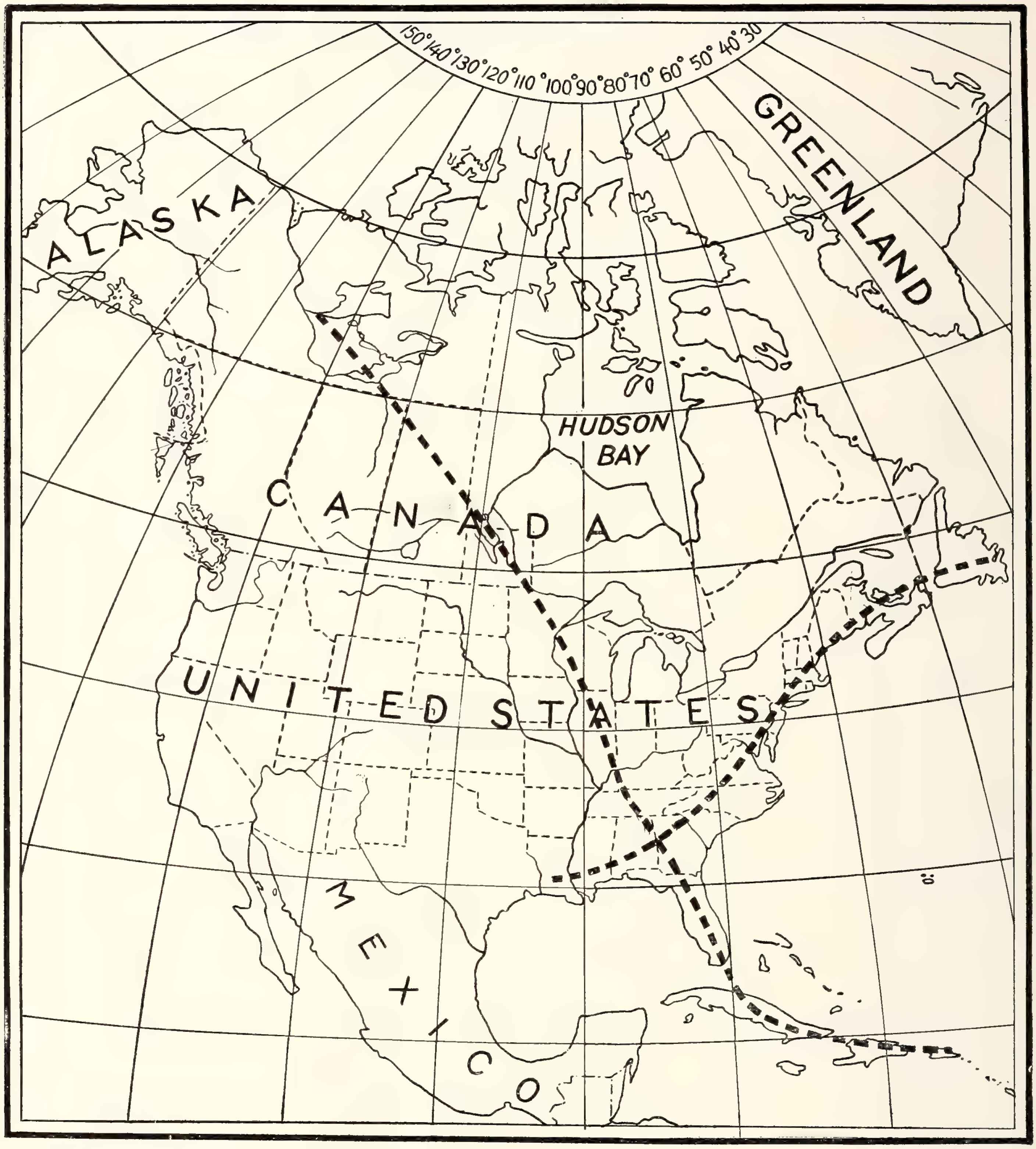
The next two maps (pages 348 and 349) show the extremes of direct and circuitous routes of migration. All black-poll warblers winter in South America. Those that are to nest in Alaska strike straight across the Caribbean Sea to Florida and go northwestward to the Mississippi River. Then the direction changes and a course is laid almost due north to northern Minnesota, in order to avoid the treeless plains of North Dakota. But when the forests of the Saskatchewan are reached, the northwestern course is resumed and, with a slight verging toward the west, is held until the nesting site in the Alaska spruces is attained.

The cliff swallows are winter neighbors in South America of the black-poll warblers. But when in early spring nature prompts the swallows who are to nest in Nova Scotia to seek the far-off land where they were hatched, they begin their journey to that region—which is situated exactly north of their winter abode—by a westward flight of several hundred miles to Panama. Thence they move leisurely along the western shore of the Caribbean Sea to Mexico and, still avoiding any long trip over water, go completely around the western end of the Gulf. Hence as they cross Louisiana they are moving in the opposite direction from that in which they started. A northeasterly course from Louisiana to Maine, and an easterly one to Nova Scotia, completes their spring migration. This circuitous route has added more than 2,000 miles to the distance traveled.

THE WARBLER TRAVELS AT NIGHT, THE SWALLOW BY DAY

Why should the swallow elect so much more roundabout a route than that taken by the warbler? The explanation is simple. The warbler is a night migrant. Launching into the air soon after nightfall, it wings its way through the darkness toward some favorite lunch station, usually several hundred miles distant, where it rests and feeds for several days before undertaking the next stage of its journey. Its migration consists of a series of long flights from one feeding place to the next, and naturally it takes the most direct course between stations, not deviating for any body of water that can be compassed at a single flight.

On the other hand, the swallow is a day migrant. Little and often is its rule. It begins its spring migration several weeks earlier than the warbler and catches each day's rations of flying insects during a few hours of slow evolutions, which at the same time accomplish



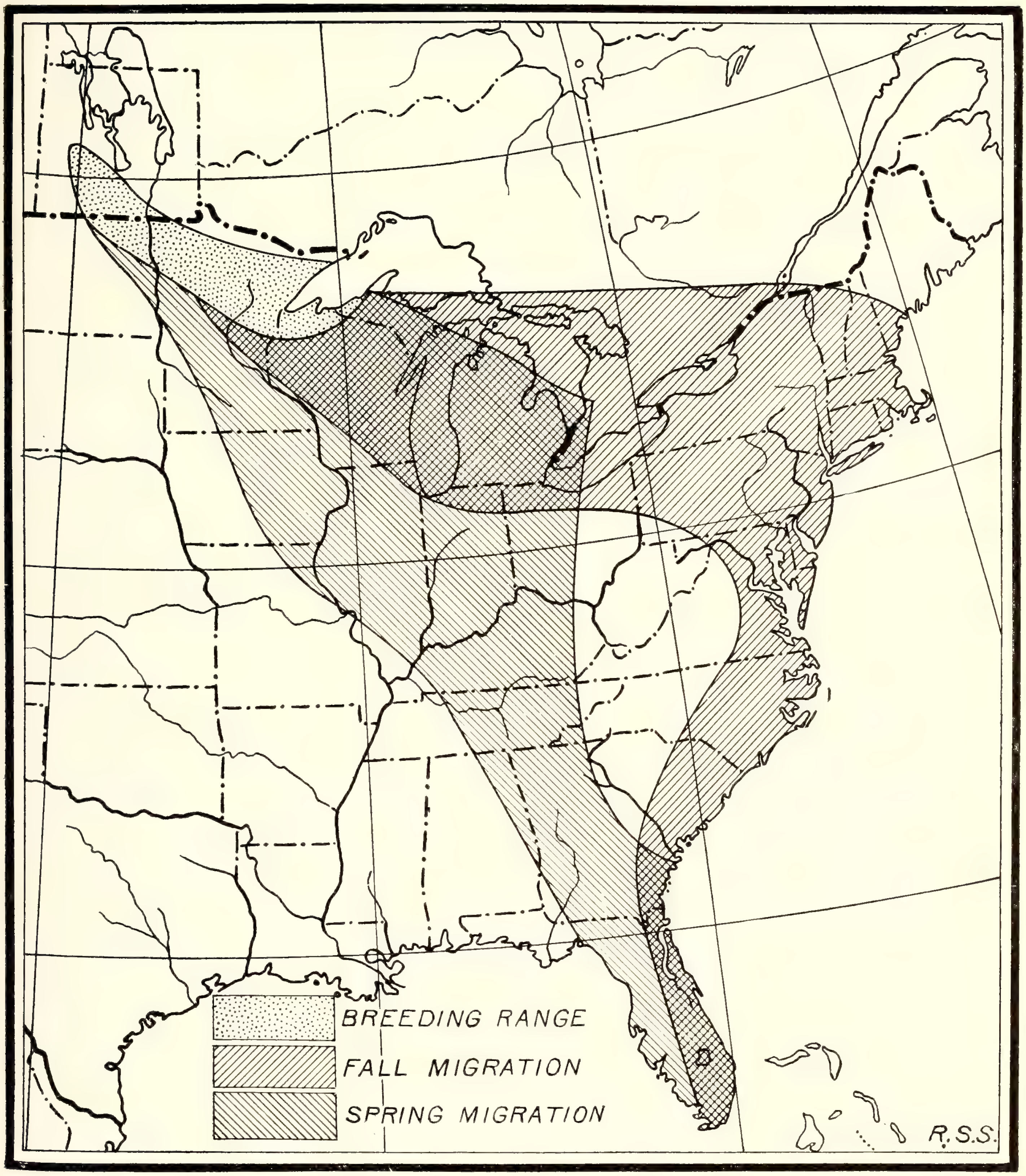
TWO OF THE PRINCIPAL MIGRATION ROUTES OF THE PALM WARBLER

They winter in the Gulf States from Louisiana eastward and throughout the Greater Antilles to Porto Rico. The Louisiana birds nest in Labrador, and those from the Antilles cut diagonally across the United States to summer in central Canada. The two routes cross each other in Georgia at approximately right angles.

the work of migration. It keeps along the insect-teeming shores, and the 2,000 extra miles thereby added to the migration route are but a tithe of the distance covered in pursuit of its daily food.

IDIOSYNCRASIES IN MIGRATION ROUTES

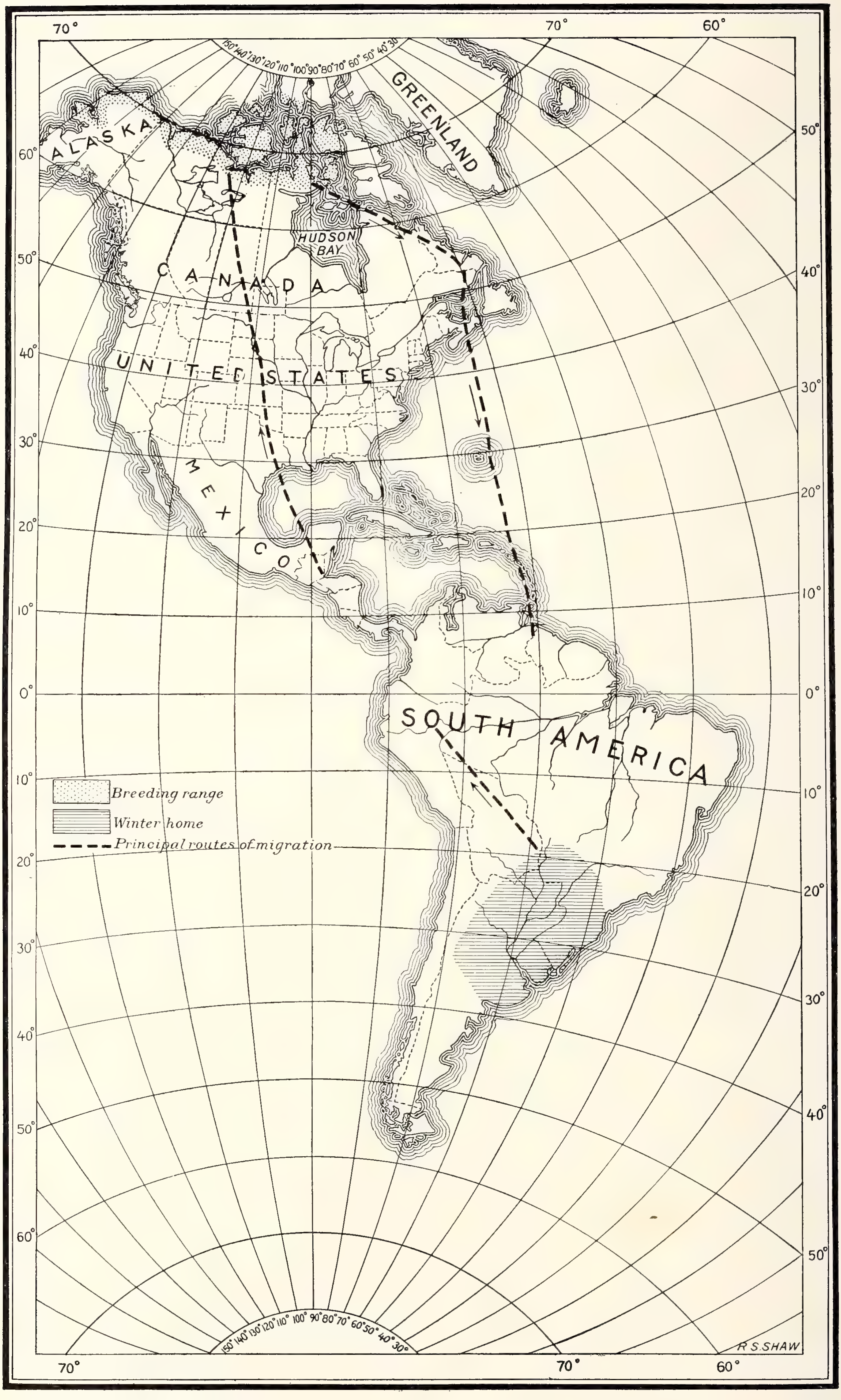
How migrating birds find their way over the widespread regions lying between their winter and summer homes has always been one of the tantalizing



THE CONNECTICUT WARBLER CHOOSES A DIFFERENT ROUTE TO RETURN TO ITS WINTER HOME THAN IT USED WHEN LEAVING IN SPRING (SEE PAGE 355)

problems of the migration student. A favorite theory of the past, and one still claiming many advocates, is that river valleys and mountain chains form convenient highways along which the birds travel in the spring, and which are easily recognized on the return trip.

The incorrectness of this theory (at least with reference to some species) is proven by the migration routes of the palm warblers. They winter in the Gulf States from Louisiana eastward and throughout the Greater Antilles to Porto Rico. They nest in Canada from the Mackenzie Valley to Newfoundland. To carry out the above theory, the Louisiana



THE LONGEST SINGLE FLIGHT MADE BY ANY BIRD—2,500 MILES ACROSS THE OCEAN FROM NOVA SCOTIA TO SOUTH AMERICA

This map shows the migration route of the golden plover, which uses a different course on its return from its winter home (see page 355) palm warblers should follow up the broad, open highway of the Mississippi River to its source and go thence to their breeding grounds, while the warblers of the Antilles should use the Alleghany Mountains as a convenient guide.

As a matter of fact, as shown on the map (page 352), the Louisiana birds nest in Labrador, and those from the Antilles cut diagonally across the United States to summer in central Canada. The two routes cross each other in Georgia at approximately right angles.

Another idiosyncrasy of bird migration is the adoption by the Connecticut warbler of different routes for its southward and northward journeys. All the individuals of this species winter in South America, and, as far as known, all go and come by the same direct route between Florida and South America, across the West Indies; but north of Florida the spring and fall routes diverge. The spring route (page 353) leads the birds up the Mississippi Valley to their summer home in southern Canada; but fall migration begins with a 1,000-mile trip almost due east to New England, whence the coast is followed southwest to Florida.

The Connecticut warbler is considered rare, but the multitudes that have struck the Long Island light-houses during October storms show how closely the birds follow the coast-line during fall migration.

The map represents the spring-migration route as far as at present known. The fact that the route is practically north and south through Ohio and then turns abruptly west indicates a large and as yet undiscovered breeding area in Ontario north of lakes Huron and Superior. Indeed, so little is known about the nesting of the Connecticut warbler that the eggs obtained by Mr. Seaton more than 25 years ago still remain unique.

Incidentally this route of the Connecticut warbler is a conclusive argument against the theory that migration routes indicate the original pioneer path by which the birds invaded the region of their present summer homes.

THE LONGEST CONTINUOUS FLIGHT IN THE WORLD—2,500 MILES

Such elliptical migration routes as that mentioned above are rare among land birds, but are used and on a far larger scale by many water birds, notable among which is the golden plover. This species nests along the Arctic coast of North America, and as soon as the young are old enough to care for themselves fall migration is begun by a trip to the Labrador coast, where the plover fattens for several weeks on the abundant native fruits. A short trip across the Gulf of St. Lawrence brings it to Nova Scotia, the starting point for its extraordinary ocean flight, due south to the coast of South America (page 354).

The golden plover takes a straight course across the ocean, and, if the weather is propitious, makes the whole 2,400 miles without pause or rest. But if tempests arise, it may be blown out of its course to the New England coast and start anew on the advent of fair weather; or it may rest for a few days at the Bermudas, one-third of the way along its course, or at the nearest of the Lesser Antilles, still 600 miles from the mainland of South America. These, however, are emergency stop-overs, to be resorted to only in case of storms. Having accomplished its ocean voyage, it passes across eastern South America to its winter home in Argentina.

After a six months' vacation here, the plover finds its way back to the Arctic by an entirely different route. It travels across northwestern South America and the Gulf of Mexico, reaching the United States along the coasts of Louisiana and Texas. Thence it moves slowly up the Mississippi Valley and by early June is again at the nesting site on the Arctic coast. Its round trip has taken the form of an enormous ellipse, with a minor axis of 2,000 miles and a major axis stretching 8,000 miles from Arctic America to Argentina.

HOW DID THE GOLDEN PLOVER COME TO USE SUCH A DIFFICULT ROUTE?

The evolution of the elliptical route of the golden plover, wonderful though it is in its present extended form, is easily traced through its various stages. Toward the end of the glacial era, when the ice began to recede, the peninsula of Florida was submerged and a comparatively small area of land in the southeastern United States was free from ice. Any golden plover that attempted to follow up the retreating ice must have been confined to an all-land route from Central America through Mexico and Texas to the western part of the Mississippi Valley. As larger areas of the eastern United States were uncovered and became available for bird habitation, extension of the route would be to the northeast, until in time the whole of the Mississippi Valley to the Great Lakes could be occupied.

As the migration route lengthened and powers of flight developed, there would arise a tendency to straighten the line and shorten it by cutting off some of the great curve (No. 1, page 357) through Texas and Mexico. A short flight across the western end of the Gulf of Mexico was finally essayed (No. 2), and this gradually lengthened and its points of departure and arrival moved eastward until eventually the roundabout curve through Texas was discarded and the flight was made directly from southern Louisiana across the Gulf (No. 3).

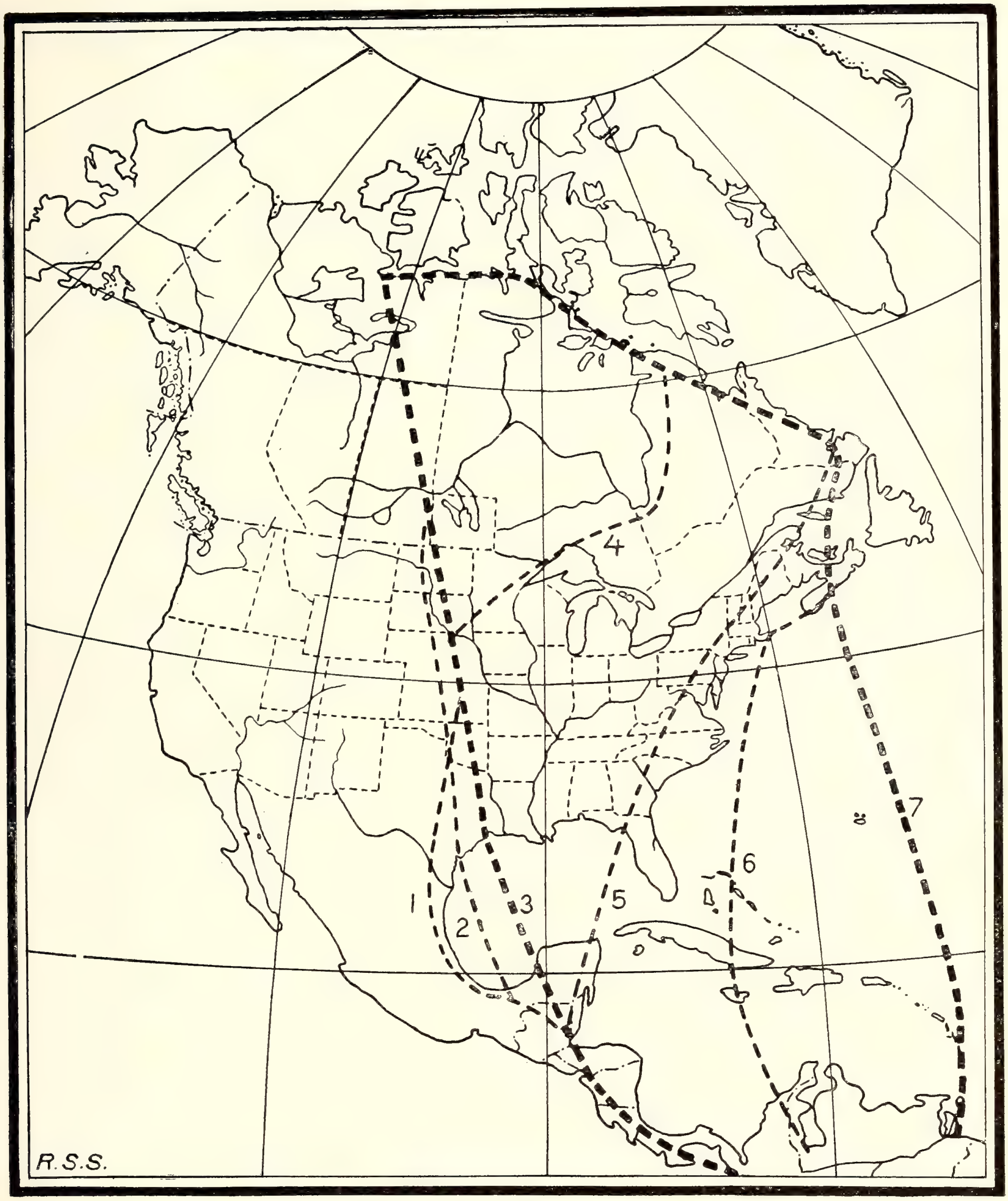
As the great areas of Canada were added to the birds' domain, other conditions arose. Here appeared a vast new stretch of coast and plain—the Labrador peninsula—offering in the fall rich stores of the most delectable berries and fruits; but at migrating time, in the spring, bound by frost and shrouded in fog. Since Chinook winds made the climate of the interior of the continent just east of the Rocky Mountains especially favorable for spring migration, there arose gradually a dividing of the spring and fall routes, the fall route tending eastward (No. 4), while the spring route remained unchanged. When the fall route had worked eastward to the Gulf of St. Lawrence (No. 5), a shortening began to take out the great westward curve of the New England coast. A short ocean flight was attempted (No. 6); and, when this proved successful, it was extended until the present direct route (No. 7) across the Atlantic was obtained.

HOW DOES THE PLOVER FIND ITS WAY EVERY SEASON TO THE LITTLE HAWAIIAN ISLANDS, 2,400 MILES ACROSS THE OCEAN?

The above gives a probable and fairly satisfactory explanation of the origin of the present migration route of the golden plover over the Atlantic Ocean. But this is a very simple problem compared with that presented by the Pacific golden plover. The Hawaiian Islands are in the middle of the Pacific Ocean, distant 2,000 miles from California on the east, 2,400 miles from Alaska on the north, and 3,700 miles from Japan to the west. Golden plover in considerable numbers fly each fall the 2,400 miles across an islandless sea from Alaska to Hawaii, spend the winter there, and fly back again the next spring to nest in Alaska. But how did they first find their way to Hawaii?

It is not to be supposed that any birds would deliberately strike out over unknown seas hunting for a new winter home. It is scarcely more probable that, even if a large flock was caught in a storm and carried far out of its course to the Hawaiian shores, the birds would change in a single season habits of countless generations and start at once a radically new migration route. It has already been said that present migration routes are evolutions—age-long modifications of other routes. The problem, then, is to find some migration route from which the golden plover's present Hawaiian-Alaskan route could have been easily and naturally derived.

The bird breeds on the northern shores of eastern Siberia, from the Liakof Islands to Bering Strait, and on the Alaska side of the strait south to the northern



MAP SHOWING THE EVOLUTION OF THE PRESENT MIGRATION ROUTE OF THE GOLDEN PLOVER (SEE PAGE 356)

base of the Alaska peninsula (page 359). It winters on the mainland of southeastern Asia, in the eastern half of Australia, and throughout the islands of Oceanica, from Formosa and the Liu Kiu Islands on the northwest to the Low Archipelago in the southeast.

The breeding range has an east-and-west extension of about 1,700 miles, while the winter home extends nearly half around the globe—10,000 miles—from India to the Low Archipelago. Undoubtedly the original migration route was approximately north and south, between the nests in Siberia and the winter resorts in southern Asia. In the course of time the species spread eastward in the winter to Australia, to the islands along the eastern coast of Asia, and throughout Oceanica, while at the same time the breeding range was extended eastward across Bering Strait to Alaska.

If all these extensions took place before there was any cutting off of corners in the migration route, then at this stage of development the Alaska-breeding birds were journeying over 11,000 miles (page 359, No. 1) to reach the Low Archipelago, distant only a little more than 5,000 miles in an air-line.

It is fair to suppose that early in the course of the eastward extension among the Pacific islands, the plover began to shorten the roundabout journey by flights from the northern islands to eastern Asia, and finally to Japan (No. 2). The most northern island is Palmyra, and the flight from there westward to the nearest of the Marshall Islands is about 2,000 miles; thence a 3,000-mile journey, with several possible rests, brings the birds to Japan.

It is easily possible that birds accustomed to this 5,000-mile flight might be driven by storms a thousand miles out of their course and discover Hawaii. When from Hawaii they attempted to reach Japan (No. 3) they would find a chain of islands stretching for 1,700 miles in the desired direction, and the final flight of 2,000 miles from the last of these—the Midway Islands— to Japan would be no longer than previous flights to which they had become accustomed.

Having once learned the route from the Midway Islands to Japan, it would be natural that the place of alighting on the Asiatic coast should be gradually carried north and east until the direct flight was made from the Midway Islands to the Aleutians (No. 4). A natural and easy carrying of this line eastward would result in the present route (No. 5) between Hawaii and Alaska.

NEIGHBORS AND STRANGERS

Both the American and Pacific golden plovers nest in Alaska near Bering Strait, the former on the north and the latter on the south side of the strait. The American bird reached there by a westward extension from Canada, and the Pacific by an eastward extension from Siberia. The birds themselves are so nearly alike that only an expert can distinguish them; and, notwithstanding they are such near neighbors during the summer—scarcely a hundred miles apart—the beginning of migration makes them utter strangers; for those north of the strait travel 3,000 miles east and then 6,000 miles south to Argentina, while the others make a 3,000-mile flight directly south to their winter home in Hawaii.

THE WORLD'S MOST EXTRAORDINARY TRAVELER

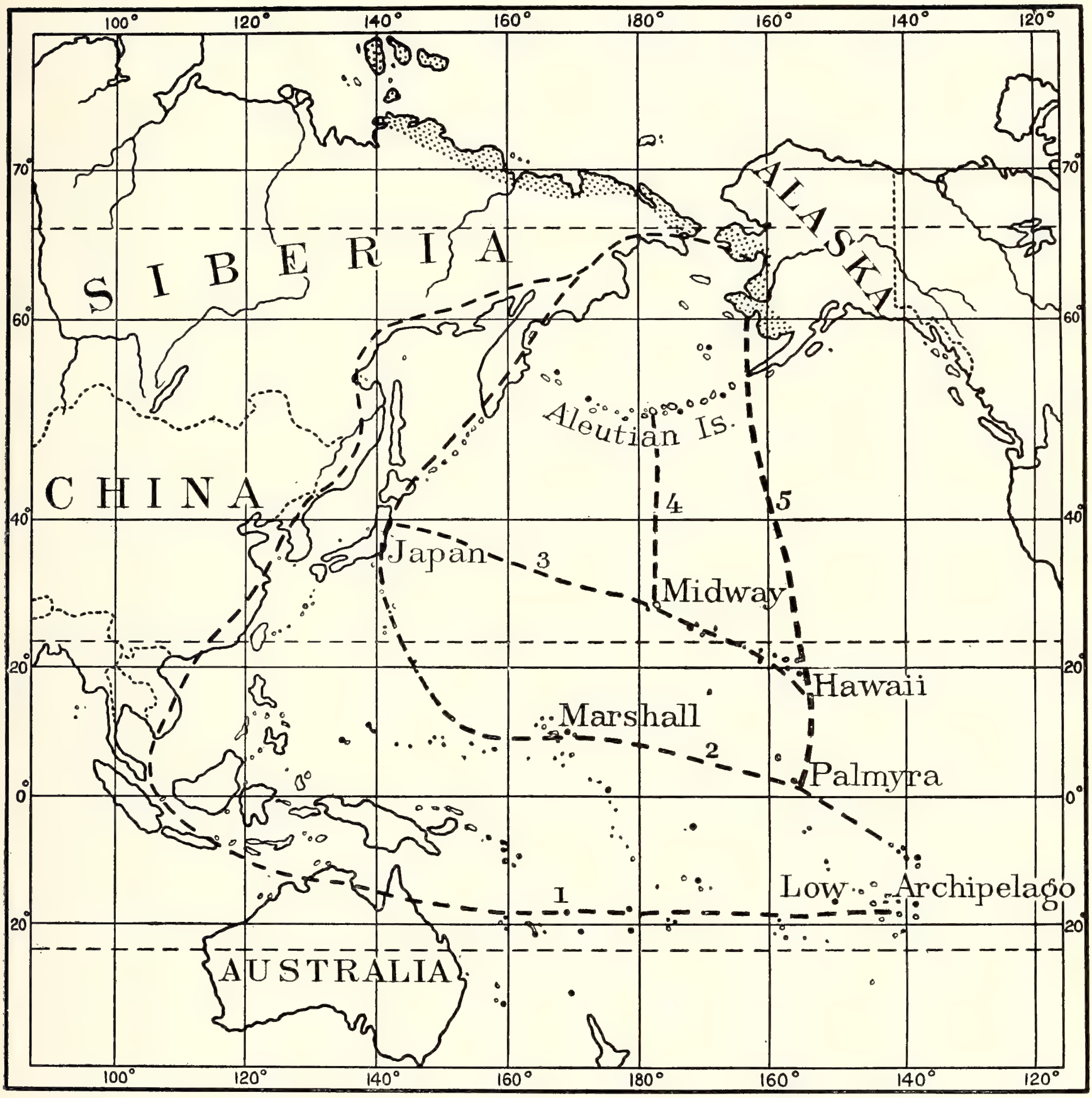
The shore-birds, such as the golden plover, present the longest migration routes among land-feeding birds; but even their surprising records are surpassed by some of the birds which glean their living from the waters. The world's migration champion is the Arctic tern page 360). It deserves its title of Arctic, for it nests as far north as land has been discovered; that is, as far north as the bird can find anything stable on which to construct its nest.

Indeed, so Arctic are the conditions under which it breeds that the first nest found by man in this region, only 7½ degrees from the pole, contained a downy chick surrounded by a wall of newly fallen snow that had been scooped out of the nest by the parent.

When the young are full grown the entire family leaves the Arctics, and several months later they are found skirting the edge of the Antarctic continent.

What their track is over that 11,000 miles of intervening space no one knows. A few scattered individuals have been noted along the United States coast south to Long Island, but the great flocks of thousands and thousands of these terns which alternate from one pole to the other have never been met by any trained ornithologist competent to learn their preferred path and their time schedule.

The Arctic terns arrive in the far north about June 15 and leave about August

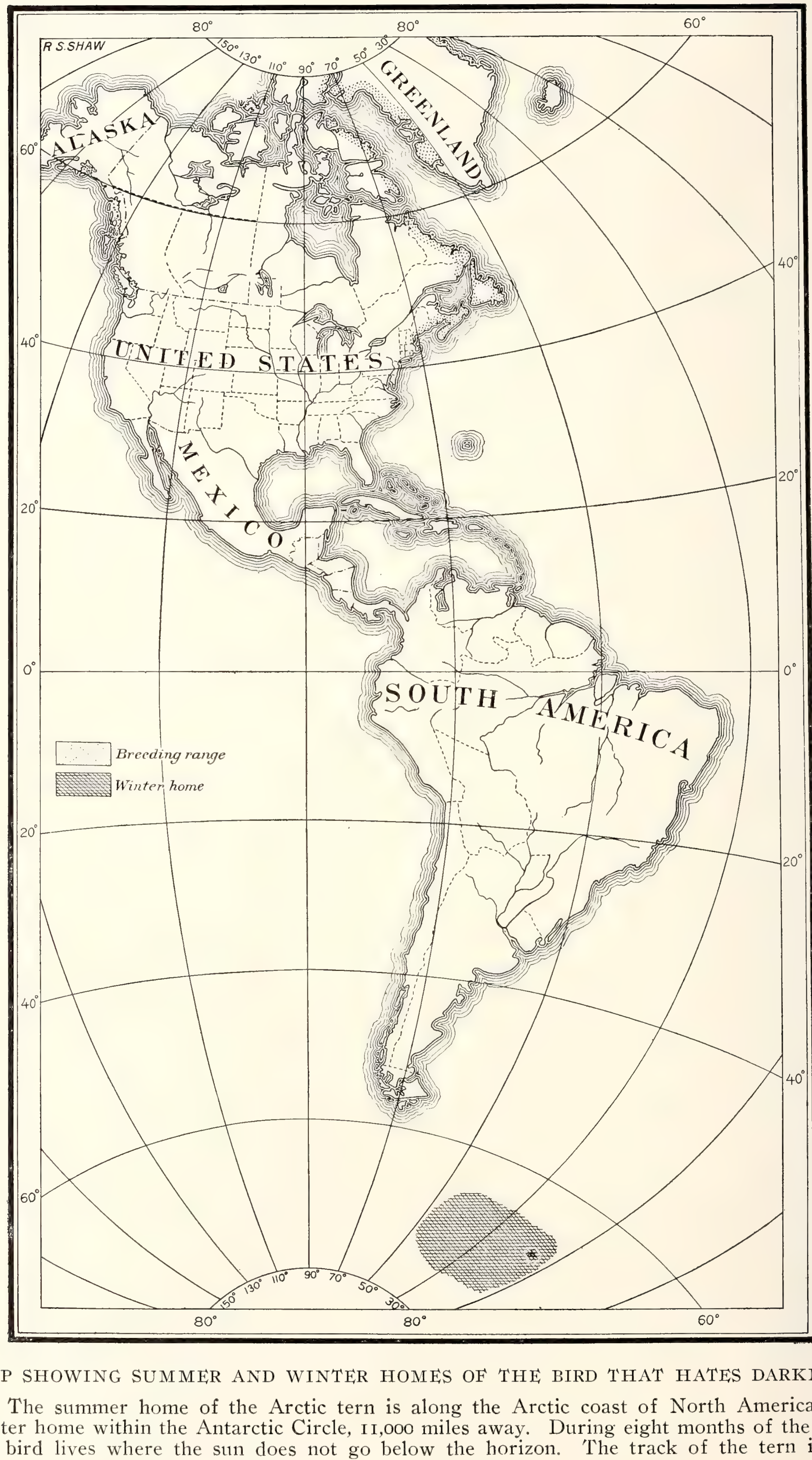


MAP TO EXPLAIN HOW THE GOLDEN PLOVER IS ABLE TO NAVIGATE TO THE HAWAIIAN ISLANDS IN THE MID-PACIFIC (SEE PAGES 356 AND 358)

The longest ocean trip without any possibility of resting is shown in this map. This is the same distance as traversed by the Atlantic plover, but the latter can get to land when in trouble. The dotted lines along the Arctic coast show the breeding range of the bird.

25, thus staying 14 weeks at the nesting site. They probably spend a few weeks longer in the winter than in the summer home; and, if so, this leaves them scarcely 20 weeks for the round trip of 22,000 miles. Not less than 150 miles in a straight line must be their daily task, and this is undoubtedly multiplied several times by their zigzag twistings and turnings in pursuit of food.

The Arctic terns have more hours of daylight and sunlight than any other animals on the globe. At their most northern nesting site, the midnight sun has already appeared before their arrival, and it never sets during their entire stay at the breeding grounds. During two months of their sojourn in the Antarctic they do not see a sunset, and for the rest of the time the sun dips only a little



MAP SHOWING SUMMER AND WINTER HOMES OF THE BIRD THAT HATES DARKNESS

The summer home of the Arctic tern is along the Arctic coast of North America; its winter home within the Antarctic Circle, 11,000 miles away. During eight months of the year the bird lives where the sun does not go below the horizon. The track of the tern in its round journey of 22,000 miles is unknown (see page 359).

way below the horizon and broad daylight continues all night. The birds therefore have 24 hours of daylight for at least eight months in the year, and during the other four months have considerably more daylight than darkness.

THE MOVEMENTS OF THE ROBIN

The number of miles traveled per day by a migrating bird varies greatly in different parts of the migration journey. These variations are intimately connected with corresponding variations in the speed of the northward march of spring, and are based primarily on two facts: First, that the interior of a continent warms up faster than the coasts; second, that spring is hastened in western North America by the Japan current, while it is as decidedly retarded in the east by the polar current.

The results of these two causes are strikingly shown in the migration of the robin (page 362). This bird differs from most others in that throughout its entire course northward it adopts spring's timetable for its own.

The robin's average temperature of migration is 35° F.; that is, it puts in an appearance soon after the snow begins to melt and streams to open, but before vegetation has made any start. These conditions occur in the central Mississippi Valley about the middle of February, and it is the first of March before spring and the robins cross northern Missouri and arrive together in southern Iowa. Thence a whole month is consumed by the birds in their slow progress—13 miles a day—to central Minnesota. There their pace quickens, to keep up with the northward rush of spring, and another 10 days at doubled speed brings them to southern Canada.

Here they must make an important choice. To the north and northeast lies a land that awakens slowly from its winter's sleep, and where the sun must wage a protracted contest against the cold of the ice-masses in Lake Superior and Hudson Bay. To the northwest stretches a less forbidding region, already quickening under the influence of the Chinook winds.

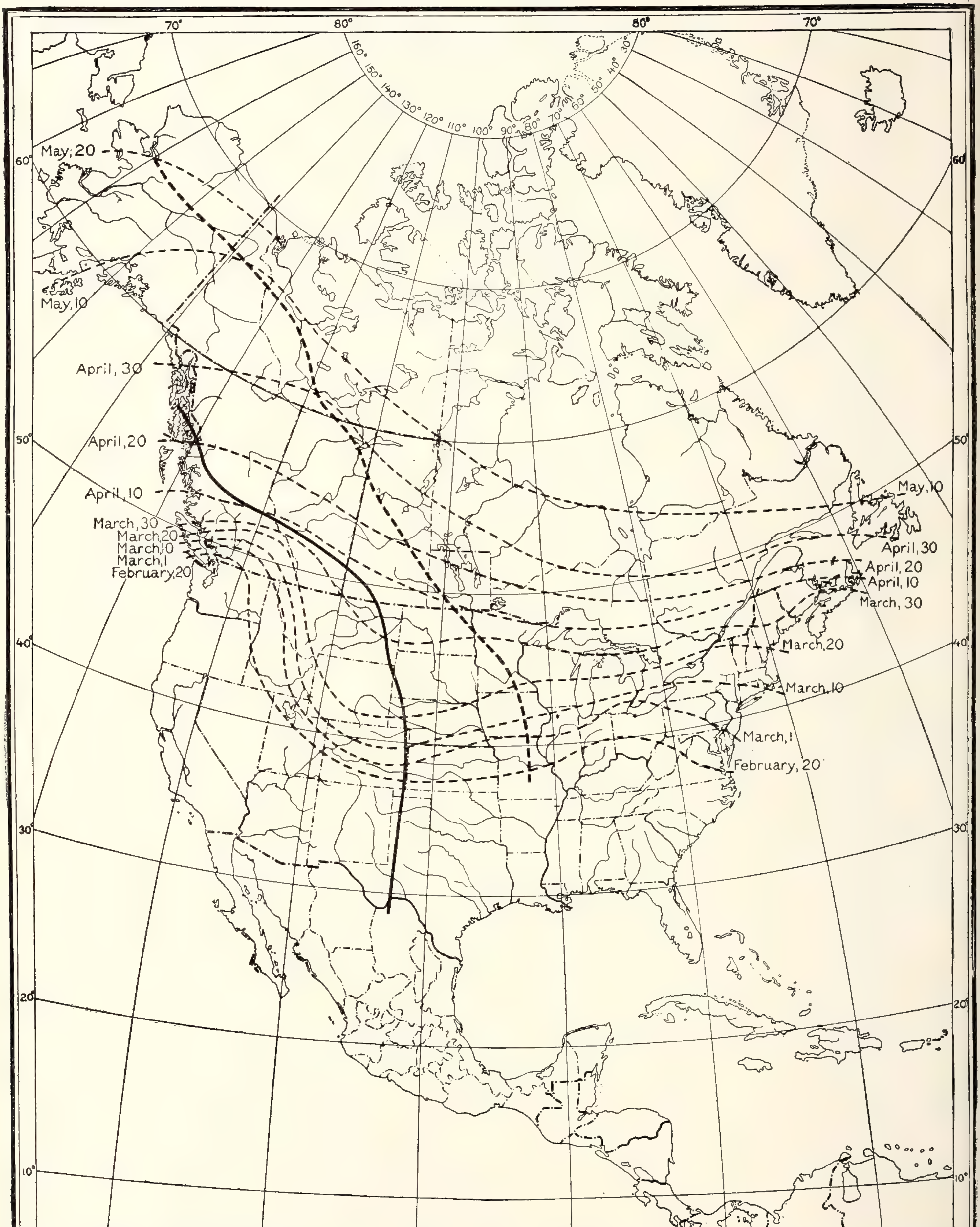
THE EASTERN ROBINS MOVE SLOWLY, THE PACIFIC MUCH FASTER

Most of the robins from Missouri that pass through western Minnesota elect to turn to the northwest, and now they must not only keep pace with the rapidly advancing season, but must do so while traveling on a long-drawn-out diagonal. Their daily average rises to 50 miles—four times that in southern Iowa—and later, when for the birds bound for western Alaska the course becomes nearly due west, the rate increases to 70 miles a day—more than six times the speed with which the journey began.

The migration map of the robin shows that these Alaska-breeding birds are the only ones that develop high speed. The robins bound for Newfoundland move leisurely along the Atlantic coast at the proverbially slow rate of the oncoming of spring in New England, and, scarcely exceeding 17 miles a day, they finally arrive at their destination May 6, when their Alaska-bound relatives are already 1,200 miles farther north.

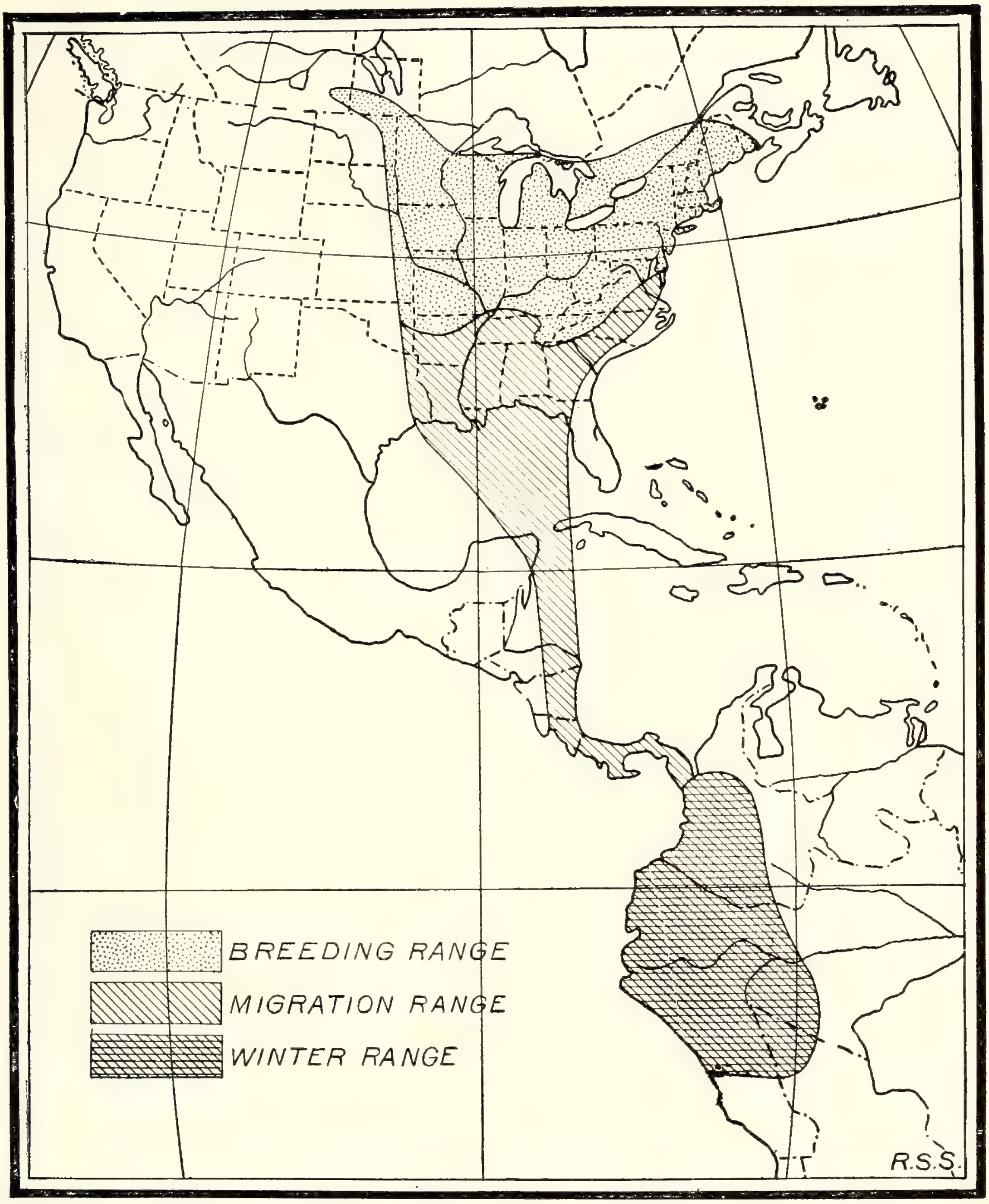
One of the most interesting things indicated on the map is the migration route of the robins who nest in southern Alberta. They arrive too early to have come from the south or the southeast; hence they must have come from the southwest, though this has necessitated their crossing the main range of the Rockies while the mountains were still in the grasp of winter. Robins remain all winter on the Pacific coast, north to southwestern British Columbia, which has about the same winter temperature as St. Louis, 700 miles southward. Hence the wintering robins of British Columbia are already far north at the advent of spring and do not need any hurried migration to reach Alberta on time. As a fact, they average only 8 miles a day, the slowest rate for the species.

It may be fairly asked, How do we know that the Alaska robins have come all this long distance from the central Mississippi Valley, instead of the far shorter distance from British Columbia? It happens that the robins of the two sides of the continent are slightly differ-



THE ROBIN MOVES MUCH QUICKER ON THE PACIFIC THAN ON THE ATLANTIC

The dotted lines connect the places at which the robins arrive simultaneously. The heavy solid line marks the division between the eastern and the western forms. The heavy dotted line represents the migration route of the Alaska breeding birds (see page 361).



THE SCARLET TANAGER

An example of a migration route much more contracted than either the breeding or winter range (see page 364)

ent in color and in pattern of coloration. Birds of the western style are not known north of southwestern Saskatchewan, central British Columbia, and southeastern Alaska, while the whole country to the northward is occupied by birds that evidently have come from the southeast. The heavy, solid line on the map shows the approximate meeting-ground of the two forms.

Most migrants except the robins, ducks, and geese wait in their warm winter quarters until springtime is far advanced, and then, traveling swiftly, occupy only a few days in their vernal migration. The black-poll warbler is one of the best examples.

THE WARBLERS AND CLIFF SWALLOWS

While the Alaska-breeding robins start off in February, and spend nearly 90 days in going from central Missouri to western Alaska, the black-poll warbler remains in his tropical home during February and March, and is not seen in southern Florida until about April 20.

By the first of May he arrives in central Missouri, which the robins left 60 days earlier, and yet he reaches northwestern Alaska only 10 days later than the robins. The latters' 90-day schedule has been shortened by the warbler to 30 days.

The black-poll warbler furnishes a striking example of speed acceleration during the latter part of migration. As indicated on the map of his migration route (page 348), between April 20 and April 30 he goes from central Missouri to central Iowa, a distance of 300 miles, or an average of 30 miles a day. The next 10 days the rate rises to 100 miles a day, while during the last few days of migration a velocity of 300 miles a day is attained.

In contrast, notice the dates, distances, and speeds indicated for the cliff swallow on its migration-route map (page 349). The swallow must strike out for the north very early, since by March 10 it is already 2,500 miles from the winter home, and yet is averaging only 25 miles a day for the next 20 days, while it is rounding the western end of the Gulf of Mexico. It more than doubles this rate while passing up the Mississippi and Ohio rivers. The crossing of the Alleghany Mountains comes next, and there are only 200 miles of progress to show for the 10 days of migration. By this time spring has really come east of the Alleghanies, and the swallow travels 60 miles a day to its summer home in Nova Scotia.

It is to be noted that the swallow, like the robin and the black-poll warbler, works up to high rates of speed when it is traveling on a diagonal, and that except during the 10 days spent in crossing the mountains, each 10 days' travel covers approximately five degrees of latitude.

SOME NARROW MIGRATION ROUTES

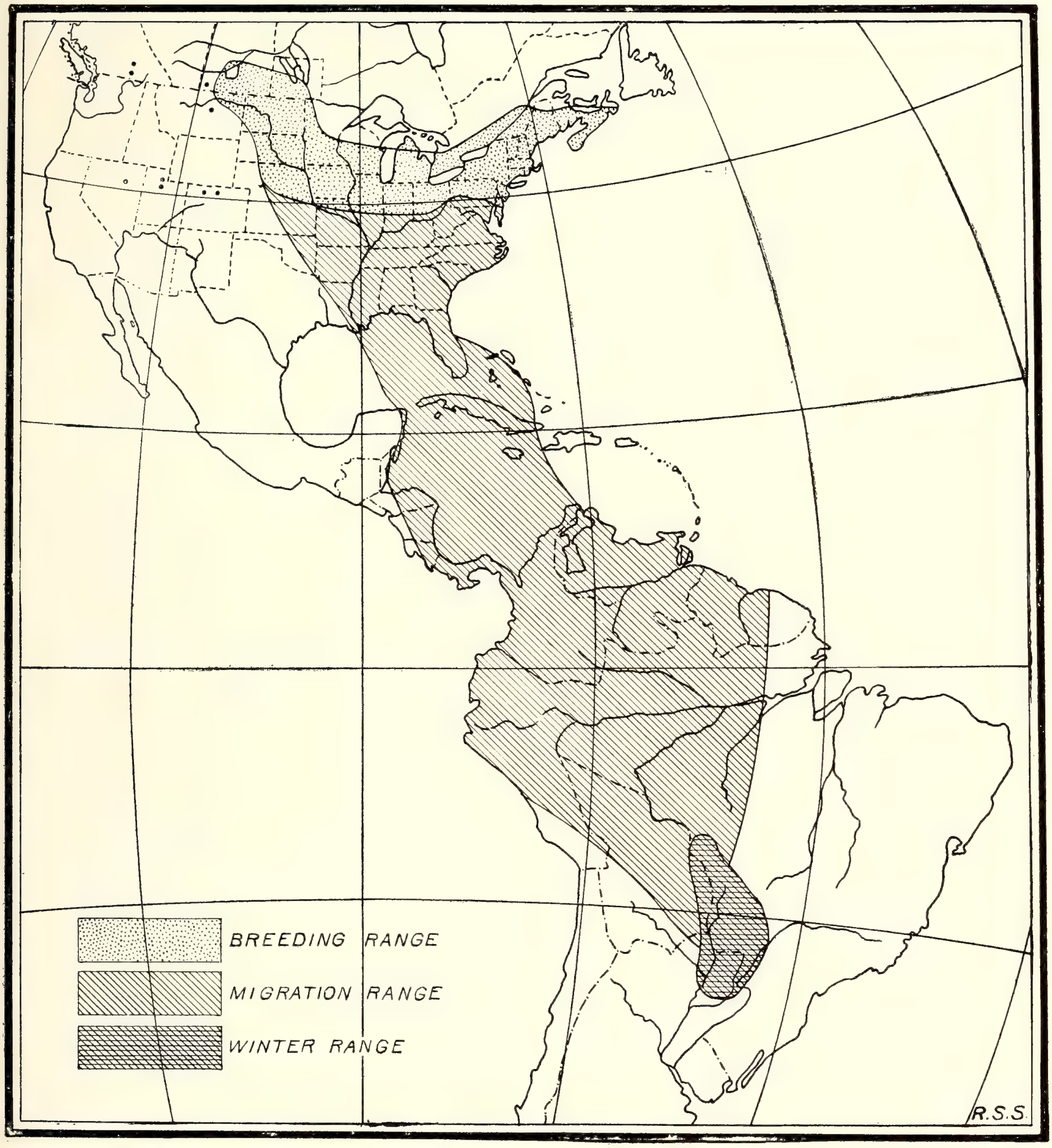
The accompanying illustration of the range of the scarlet tanager (page 363) is given to show the narrowness of the migration route as compared with the width of the summer and winter homes. This tanager nests from New Brunswick to Saskatchewan, a region extending over 1,900 miles of longitude. The Mississippi Valley birds go south and the New England birds southeast, until they all leave the United States along 800 miles of Gulf coast from Texas to Florida. The migration lines continue to converge until in southern Central America they are not more than a hundred miles apart. Arrived in South America for the winter, the birds scatter over a district about one-half the area of the summer home, with an extreme east-and-west range of about 700 miles.

THE BOBOLINKS ARE SEEKING NEW ROUTES

The migration route of the bobolink (page 365) shows a similar though not so decided a contraction at its narrowest part. The summer home extends from Cape Breton Island to Saskatchewan, 2,300 miles, and the migration lines converge toward the rice fields of the South, the objective point of all bobolinks, no matter where they nest.

Having gorged themselves to repletion, they press on toward their Brazilian winter abode; but the South Carolina and Georgia birds take a course almost at right angles to that chosen by the scarlet tanagers from those States, and strike out directly across the West Indies for South America. In this part of their journey their migration path contracts to an east-and-west breadth of about 800 miles, while a very large proportion of the birds restrict themselves to the eastern 400 miles of this route. In South America, the region occupied during the winter has about one-fifth the breadth and one-third the area of the breeding range.

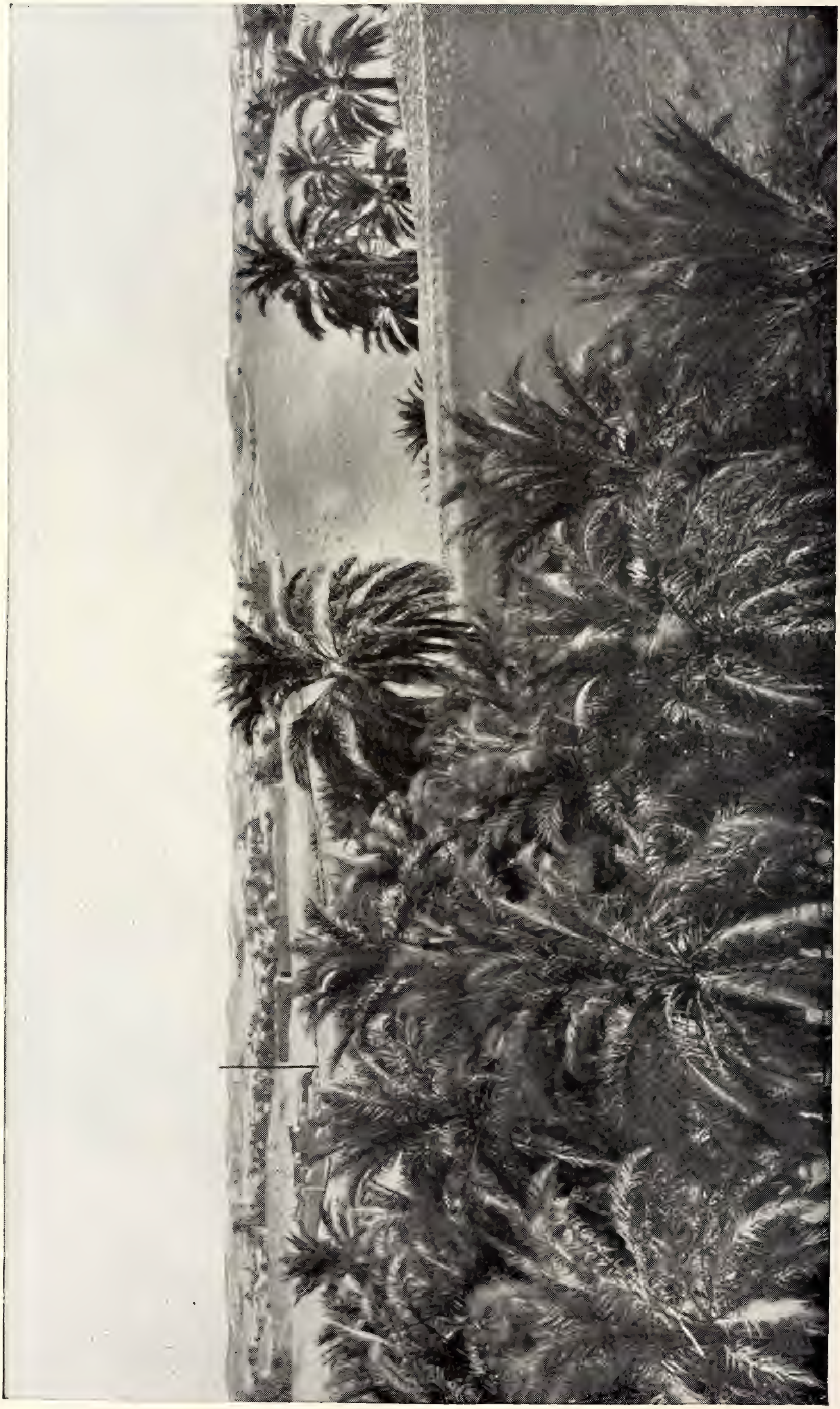
The bobolinks of New England have witnessed great numerical changes, or evolutions. When the white man arrived on the scene, nearly all of New England was covered by primeval forest and bobolink meadows were scarce. As the forest gave place to hay-fields, the bobolinks promptly took advantage of their chance and their numbers increased steadily until the maximum was reached some 40 years



THE MIGRATION ROUTE OF THE BOBOLINK IS CHANGING (SEE PAGE 364)

ago. Then the newly invented mowing machine and the horsepower hay-rake began to destroy thousands of nests and caused a marked diminution in the bobolink census.

The case of the bobolink is a fitting close to this article, because it is revealing to us at the present time the manner of evolution of a new migration route. By nature a lover of damp meadows, it was formerly cut off from the western United States by the intervening arid region. But with the advent of irrigation and the bringing of large areas under cultivation, little colonies of nesting bobolinks are beginning to appear here and there almost to the Pacific. Some of them are shown by dots on the accompanying map, and the probability is that the not distant future will see a large increase in these trans-Rocky Mountain bobolinks.



SAND DUNES AND SUNKEN DATE GARDENS OF THE OUED SOUF

THE COUNTRY OF THE ANT MEN

By Thomas H. Kearney

ONE of the most remarkable portions of the Sahara Desert is the region known as the Erg. It is a wilderness of great ridges of sand that extends from southeastern Algeria far into the hinterland of Tripoli. In the northern part of the Erg, about midway between the Jerid district of Tunis* and the Oued Rirh Valley in the Algerian Sahara, the oases of the Souf lie hidden among dunes that are almost mountainous in size.

Although less than 200 miles from the termini of three railways—Biskra and Tebessa in Algeria and Gafsa in Tunis—the Souf country is so difficult of access that it is rarely visited by Europeans. I had heard much of its marvels from the natives of the Jerid, and it was therefore with a feeling of keen anticipation that I started thither from Nefta one November morning (see map, p. 377).

Our road led first across the westernmost prolongation of the salt flat called the Chott el Jerid, which is about 70 feet below sea-level. Near the bank the salt lay like a powdery rime of hoar-frost on the dark-colored mud. As we proceeded across the Chott it became a continuous crust, like ice on a pond, but so thin and transparent that we could plainly see the muddy bottom. Gradually the crust thickened and the mud was visible only where the hoofs of camels and donkeys had broken through. In places the salt had been forced up, as if a mole had made his runways beneath, into a network of low ridges.

Striking displays of mirage were seen here. The rocky hills on the south side of the great salt pond seemed much nearer and higher than was really the case, and their jagged peaks appeared to give place to flat-topped buttes. The center of the Chott assumed the likeness of a lake of blue water, with graceful clusters of palms along its shore.

Climbing the steep bank that marks the western border of this depression, we saw before us a seemingly endless expanse of nearly level country, dotted with hummocks about waist high. Each little mound was crowned by a spiny bush of "retam" or by other gray shrubs of the desert. Among them in every direction wound faintly marked bridle paths. How the Souafa guide found his way through this maze I could not guess. Yet find it he did, rarely hesitating as to which was the right road. He seemed to be guided more by instinct than by reason, for he was generally in a state of half stupor, caused by the hashish which he smoked constantly.

We rode all day through this dreary region and supped with the clean desert sand for a table. The guide made beds of the coarse grass known as "drinn"—the principal food of camels in the Sahara—upon which we spread our blankets. The night became so cold that after the first few hours I could sleep but little. There was compensation, however, in the view of the glittering African sky, uninterrupted from the zenith all around to the horizon, that one could enjoy to the utmost while lying on the ground.

By 10 o'clock the following morning we were engaged in a labyrinth of dunes, laboring up one side of a sandhill and sliding down the other with our donkeys sinking nearly to their bellies at every step, then following one of the long trough-like stretches of hard ground that lay between the ridges of sand before starting up the next slope.

The last few miles of our journey was an excessively toilsome climbing and descending of enormous dunes, some of which must have been 500 feet high from base to summit. Nowhere could we see the smallest leaf or twig, for this sand

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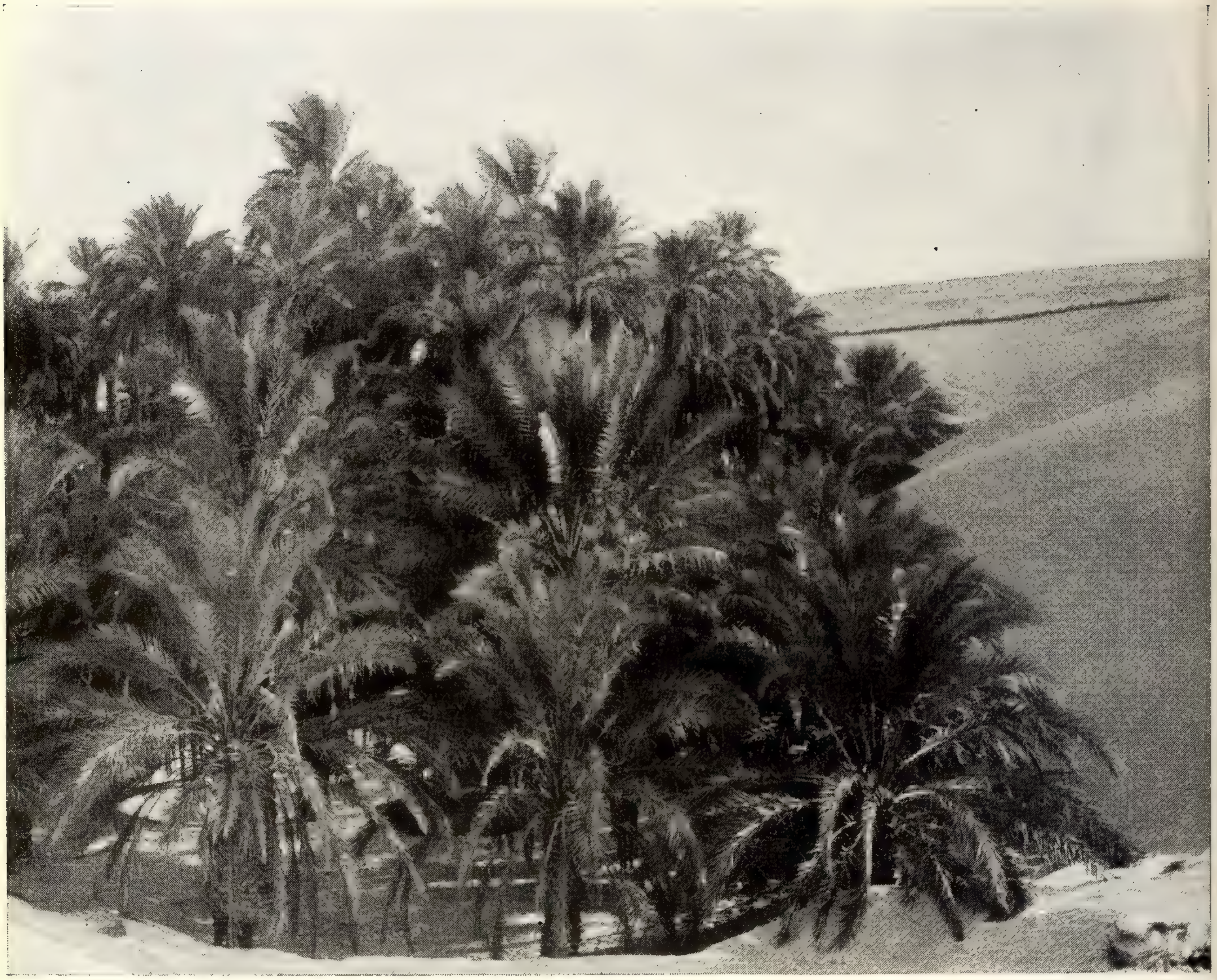
* Se "The Date Gardens of the Jerid," by Thomas H. Kearney in NATIONAL GEOGRAPHIC MAGAZINE, July, 1910.



"OFTEN THE BORDERING RIDGES WERE SO HIGH THAT EVEN THE TOPS OF THE PALMS COULD NOT BE SEEN UNTIL WE REACHED THE VERY BRINK OF THE BASIN"

The slightest puff of air suffices to start a little cloud of light sand curling from their crests. After every violent windstorm the natives must toil for days to carry the sand out of their gardens, "a veritable labor of Sisyphus" (see page 369).

is so constantly in motion that even the hardy desert grasses, with their long, creeping rootstocks and ability to resist burial, are unable to find a foothold. A striking bit of evidence of the mobility of the sand was an apparently fresh wagon track, which ran sharp and distinct for several rods, then stopped abruptly at the base of a good-sized dune, to reappear beyond it.

As the day waned these giant sandhills assumed an unearthly beauty, the dense shadows among them emphasizing their contours and contrasting most vividly with the tawny yellow of their sunlit flanks. The surface of the sand was delicately modeled with wind ripples, so that at a little distance it looked like watered silk.

We reached El Oued, the capital of the Souf, shortly after sunset. At the little hotel, kept by a Marseillais, European guests are so few and far between that, turning back three or four pages of the register, I found the name of Professor Massart, the Belgian botanist, who had visited the region six years before.

My first excursion next day was to a high point at the northeast corner of the town, where the view shown on page 366 was had. Except for the houses of El Oued behind us, nothing could be seen in every direction but great ridges of pure sand absolutely bare of vegetation.* Here and there among the dunes the clustered heads of palms projected, looking almost black by contrast with the prevailing pale buff of the sand.

Riding along the crests of the ridges, we could look down into the date gardens that nestle in the hollows among them. We found these sunken gardens —"ghitan" is the local name for them— to vary in size from mere pockets containing a dozen or a score of trees to large basins holding several hundred. Often the bordering ridges were so high that even the tops of the palms could not be seen until we reached the very brink of the basin.

The date gardens of the Souf are in constant danger of burial in the sand, for in that country the air is almost constantly in motion. During the winter the winds are generally from the northwest or northeast. In summer the prevailing wind comes from the southeast. It is not so hot as the occasional sirocco that blows from the south, but is usually more violent and carries more sand. With their steep slopes and knife-edge summits, the dunes that border the basins are peculiarly liable to wind erosion. The slightest puff of air suffices to start a little cloud of fine sand curling from their crests. In gardens that have been abandoned for a few years the trunks of the palms are sometimes entirely submerged and only the tufts of leaves protrude.

The blowing is checked in some degree by fences made of palm leaves or low walls of gypsum rock along the crests of the dunes, but after every violent storm the natives are compelled to excavate anew the floors of their gardens. It is a veritable labor of Sisyphus. The sand is carried out in baskets on the backs of men who toil up the slopes of the dunes, sinking almost to their knees at every step.

In summer, when the fierce rays of the Saharan sun beat down relentlessly and the shade temperature sometimes reaches 120° F., as much as possible of this back-breaking work is done at night. During the period when the dates are ripening especially strenuous efforts must be made to keep the sand out, as the low-hanging fruit-clusters spoil quickly if buried. Souf dates fresh from the trees are usually liberally powdered with fine sand, and this coating must be brushed or washed off before they are fit for export. The natives themselves apparently have no objection to sand as a condiment with their dates.

The gardens have a very different appearance from those of most Algerian and Tunisian oases. The palms are widely spaced, so that sunlight reaches the ground almost everywhere, and the clean sandy floor of the basins is patterned with the black shadows of the palm leaves, flecked with patches of bright light. The palms are remarkable for the great thickness of their trunks, which sometimes reach three feet in diameter. Except for an occasional fig tree or pomegranate bush, no other plants are grown at the bottom of the ghitans.

A peculiarity of the Souf region which at once strikes the traveler familiar with the ordinary oases is the absence of surface water. There are no springs nor streams, no canals and ditches for irrigation and drainage. The rain that falls at rare intervals is quickly sucked up, leaving the surface of the sand as dry as ever an hour or two afterward. But in the hollows among the dunes the water-table is usually only a few feet below the surface of the soil. The country is believed to be underlain by a subterranean river; hence its name "Oued" Souf.

In planting a date garden in this region, the first step is to sink a well in order to ascertain the depth to ground water at the bottom of the basin. It then remains only to deepen the basin so much as is needful to make the dis-

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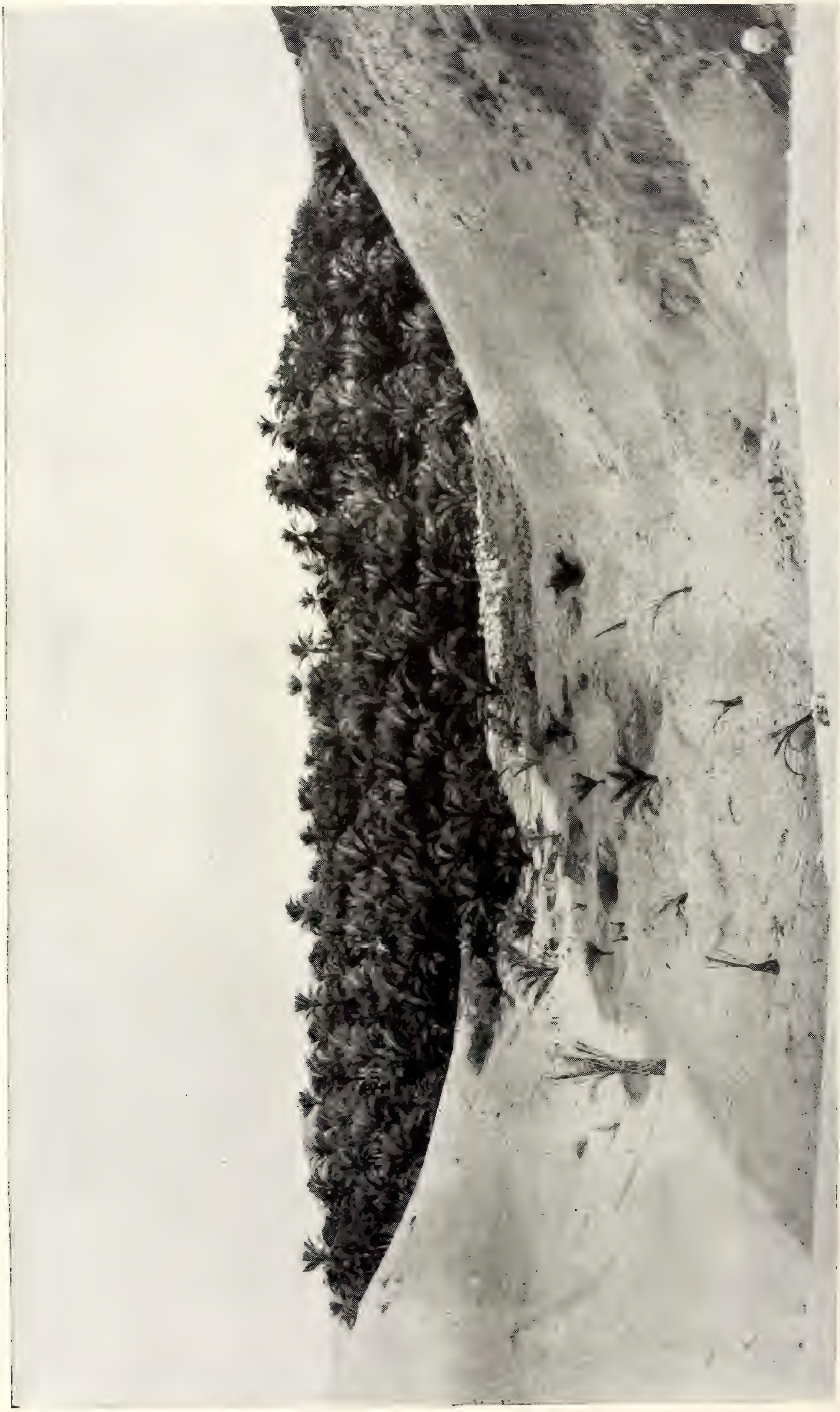
* Professor Massart could discover only eight species of flowering plants growing wild in the Oued Souf.

"DURING THE PERIOD WHEN THE DATES ARE RIPENING, STRENUOUS EFFORTS MUST BE MADE TO KEEP THE SAND OUT OF THE GARDENS, AS THE LOW-HANGING CLUSTERS SPOIL QUICKLY IF BURIED"

tance from the bottoms of the individual holes in which the offshoots are planted to permanently wet soil not greater than two or three feet. With an occasional watering by hand during the first summer, the roots of the young palms soon find their way to the underground moisture, and thereafter no irrigation is required.

The soil of the gardens being a pure

"THE PALMS ARE REMARKABLE FOR THE GREAT THICKNESS OF THEIR TRUNKS"



RECENTLY PLANTED EXTENSION OF A DATE GARDEN, MADE BY SCOOPING AWAY SAND ENOUGH TO PERMIT THE ROOTS OF THE OFFSHOOTS TO QUICKLY REACH GROUND WATER (SEE PAGES 369-370) sand and nearly always dry on the surface, the conditions are not favorable for the germination of date seeds. Consequently one misses the seedling palms bearing fruits of every description, with which the neglected gardens and waste places in other oases are crowded. This explains the fact that there are apparently no varieties of dates peculiar to the Oued Souf. Even offshoots are produced sparingly, and the natives must perforce journey to distant oases in search of them.

The dates grown in the sunken gardens of the Souf are highly reputed throughout the Sahara, being considered especially superior in sweetness and in keeping quality. This is doubtless due to the peculiar conditions under which they ripen, the sandy sides of the basins acting as reflectors, which increase the direct heat and light of the sun's rays. There being no surface moisture, the atmospheric humidity in the gardens is undoubtedly much lower than in the swamp-like oases of the Jerid and the Oued Rirh, and this also must tend to improve the quality of the fruit. Certain it is that dates ripen early in the Souf. None remained on the trees at the time of my visit (November 22-26), while in the Jerid the harvest continued that year until January. The Deglet Noor dates produced in the Oued Souf are carried by caravan to Biskra, whence they are shipped to Europe.

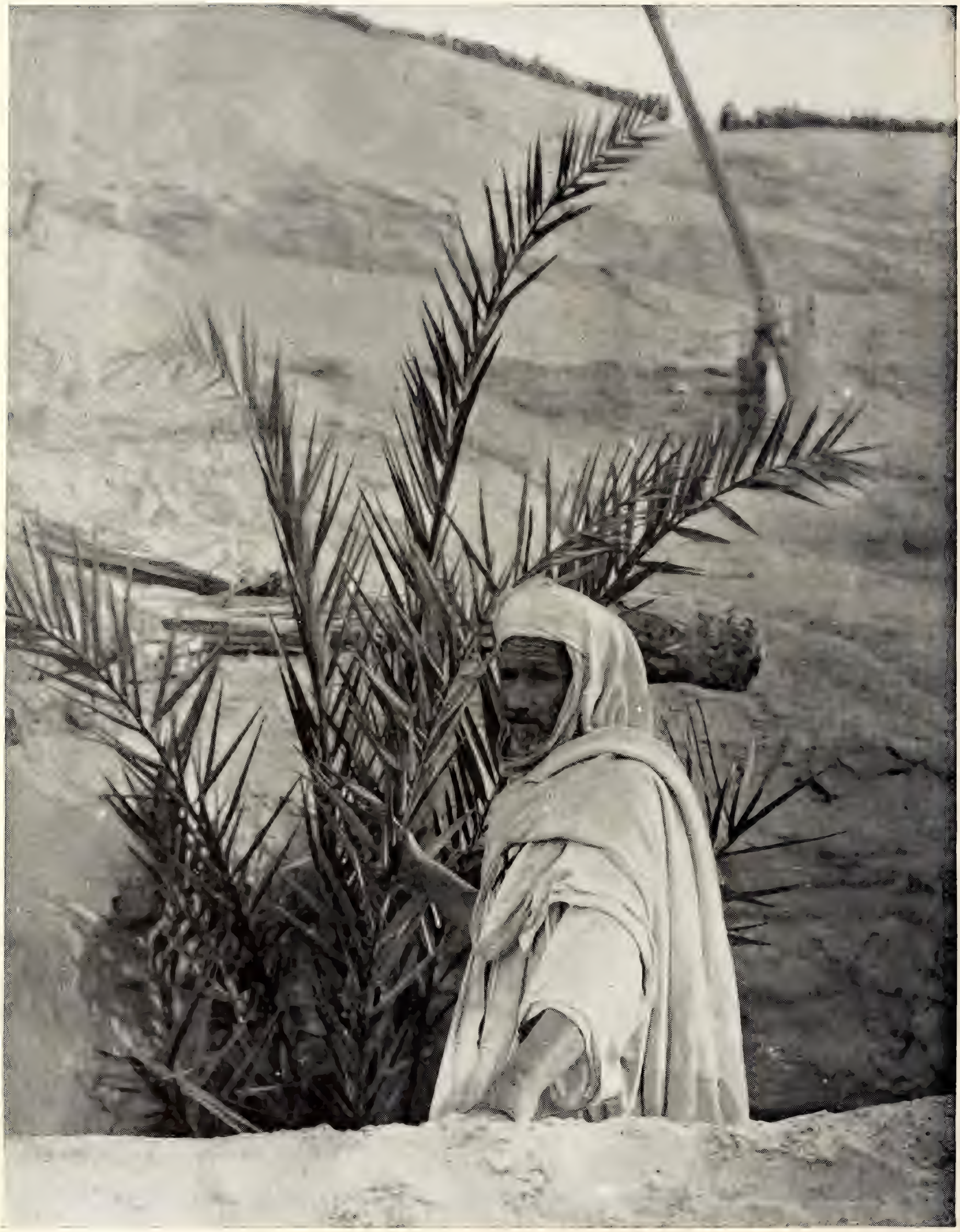
On terraces constructed in the slopes of the bordering dunes, a few feet above the floor of the basins, are located the shallow wells which furnish water for starting the palms and for irrigating the little vegetable gardens, which are also usually situated on these terraces. The water is lifted by means of a contrivance very similar to the Egyptian "shadoof." It consists of a basket daubed with pitch, hung on the end of a palm trunk that is supported between upright posts. A stone fastened to the larger end of the pole serves as a counterpoise.

Since the soil of their country is a nearly pure sand which will not stand up when wet, the Soufis are compelled to resort to plaster made from a gypseous rock in constructing the dikes by which the irrigation water is retained on their plats of vegetables. Conduits made of the same material lead the water to the plats, and plugs of wool are used to dam the tiny stream at the point where it is to be diverted. The lining of the wells is also made of this cement, and it is used in constructing the mounds with which the weakened bases of old date palms are reinforced. The rock from which this plaster is made outcrops here and there among the dunes. It frequently occurs in large clusters of crystals known as "Souf roses." The small kilns in which the rock is burned are a characteristic feature of the roadsides in some parts of the country.

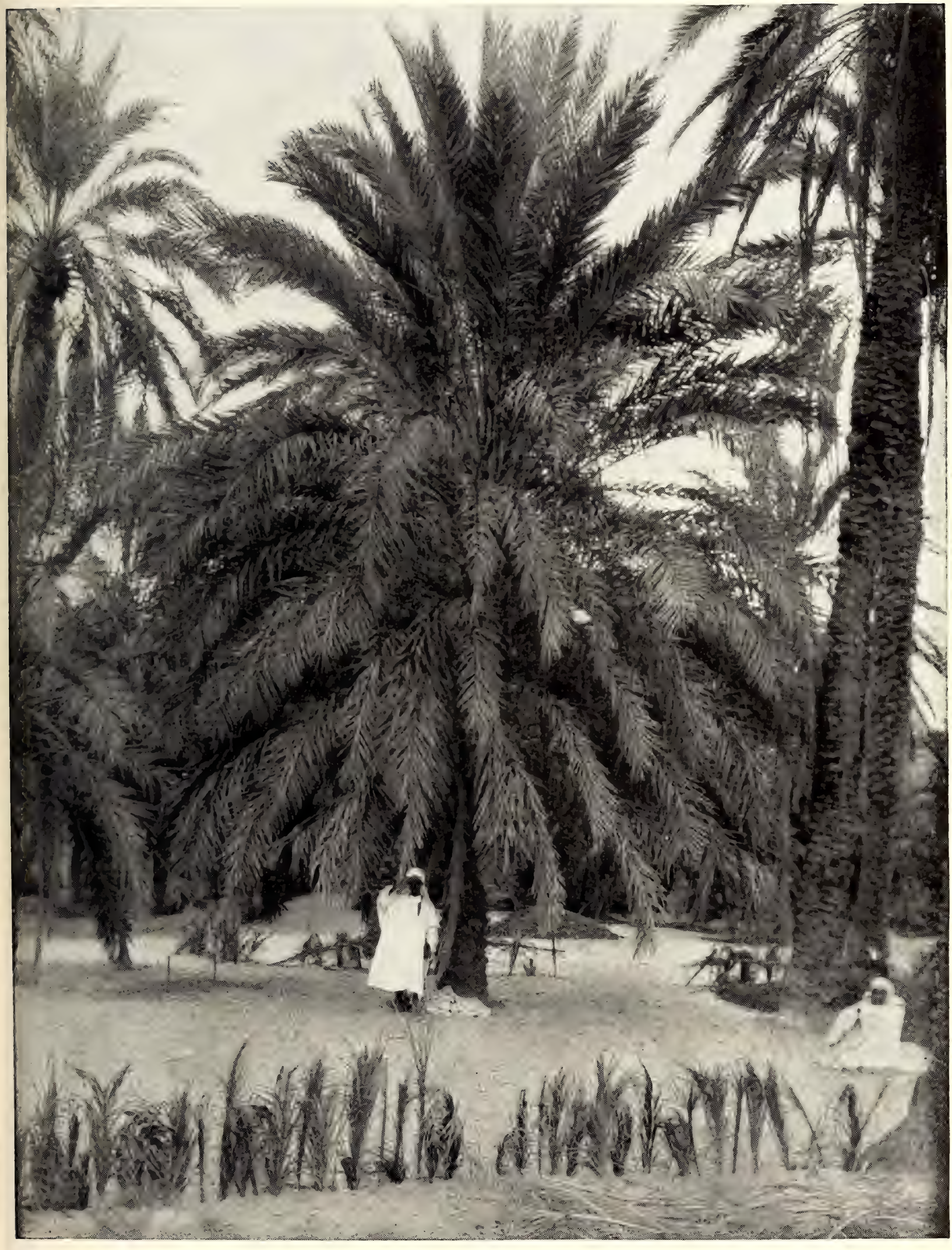
The human ants who have wrought out this highly specialized system of horticulture in the teeth of such tremendous obstacles are, it scarcely need be said, far more industrious and energetic than most of the natives of northern Africa. The Soufis not only find time for the heavy labor needed to protect their date gardens, but tend flocks of sheep and goats and manage besides a great part of the caravan business in the northern Sahara. There appears to be a tribal distinction between the more sedentary gardeners and the widely traveled conductors of caravans. The camels of the Souf are reputed to be the largest and strongest in all the great desert.

As a rule, the Soufis, like their date palms, are strong and healthy looking, being favored by their climate, which is a good one despite the intense summer heat. The absence of surface water is probably the chief reason for the healthfulness of the country. The Souf is said to be free from mosquitoes, which make life a burden during many months of the year in the Jerid and the Oued Rirh. Malaria, the scourge of the irrigated oases, is apparently unknown here.

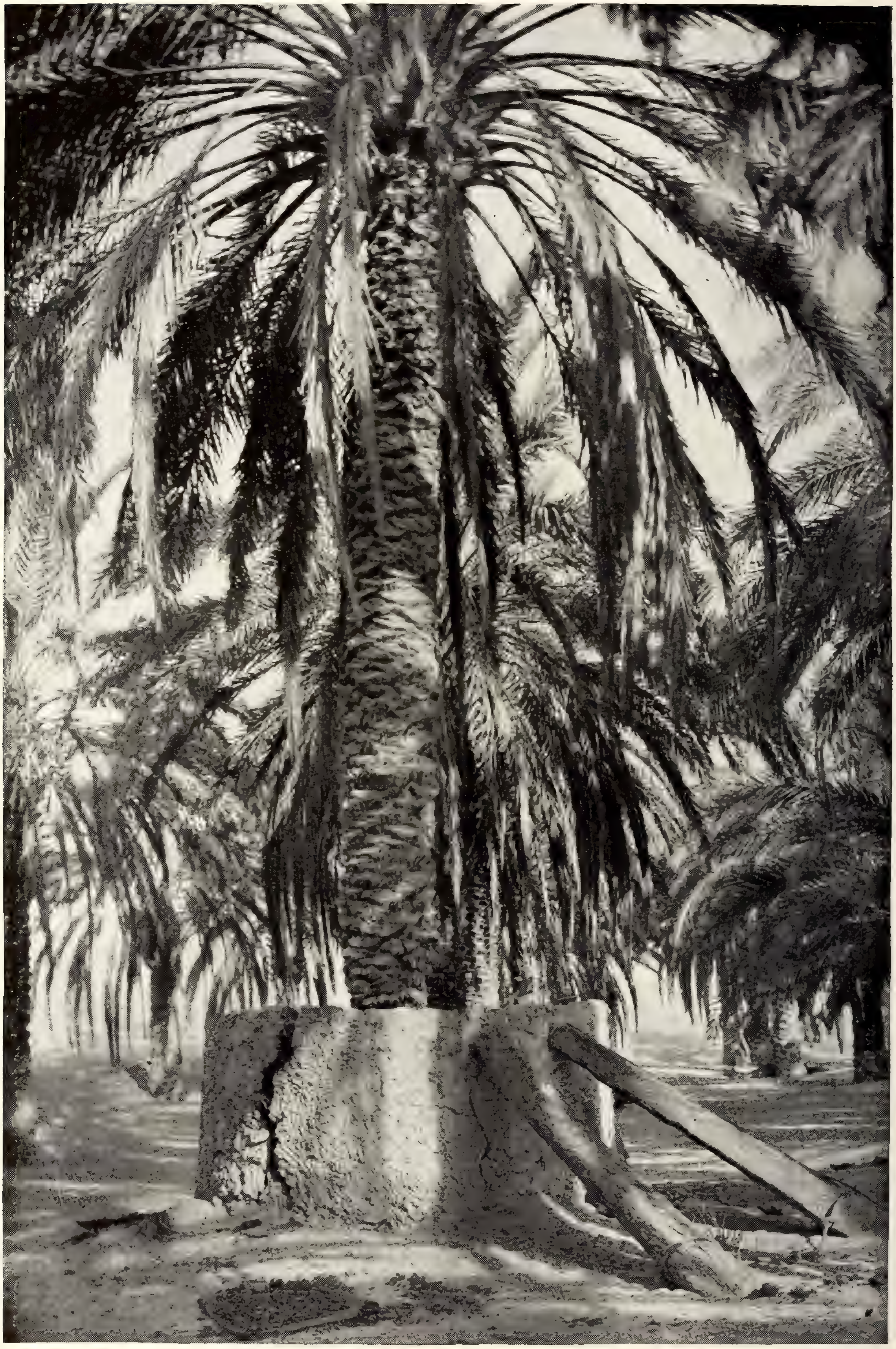
The absence of clay suitable for making the sun-baked brick of which houses are constructed elsewhere in the Sahara has put another tax upon the ingenuity



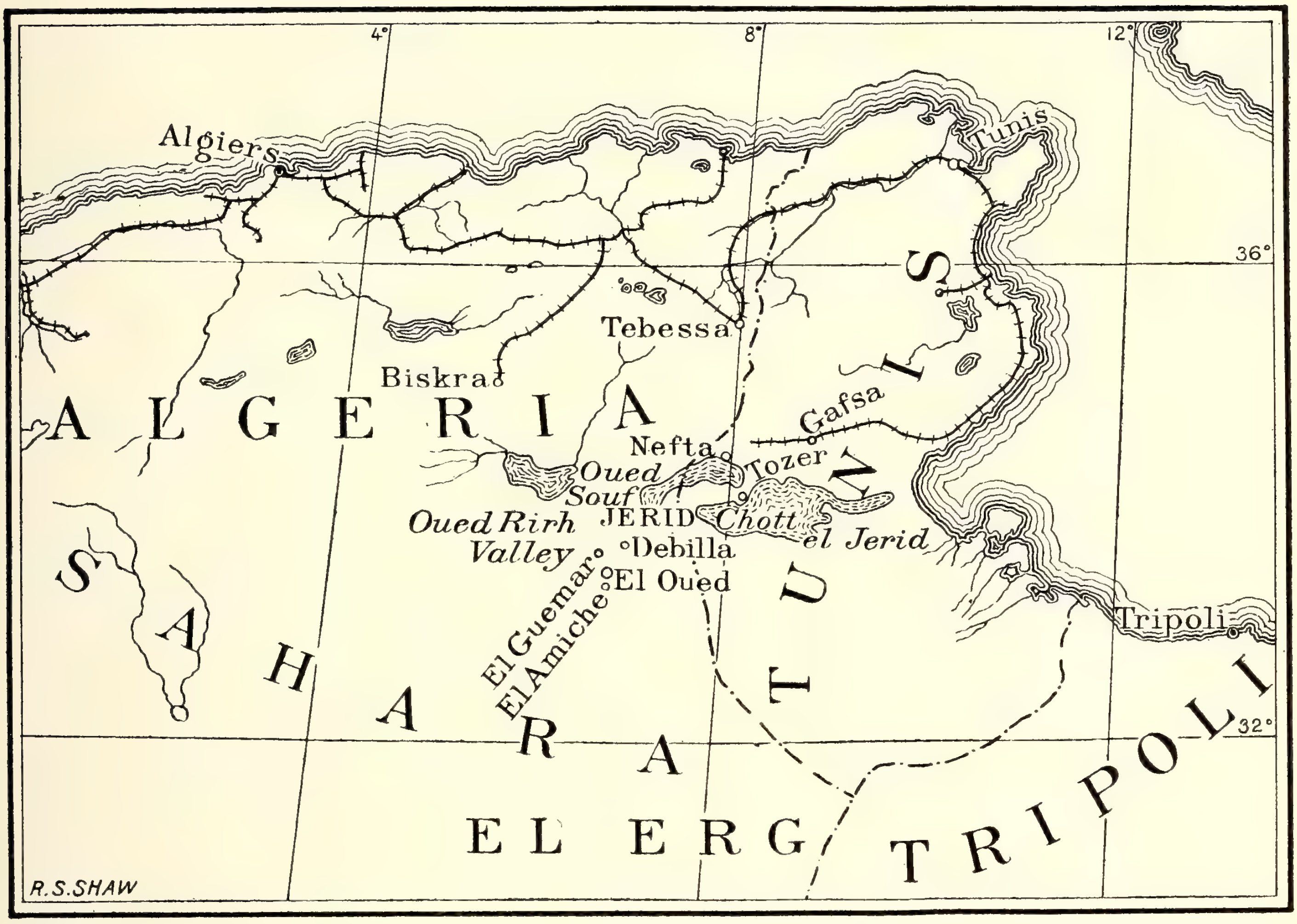
PLANTING DATE PALMS IN HOLES TWO OR THREE FEET DEEP (SEE PAGE 369)



ONE OF THE EXTENSIVELY GROWN DATE VARIETIES OF THE OUED SOUF: NOTE THE VERY HANDSOME FOLIAGE OF THIS VARIETY



THE WEAKENED BASES OF OLD PALMS ARE SUPPORTED BY CIRCULAR MOUNDS FACED WITH CEMENT



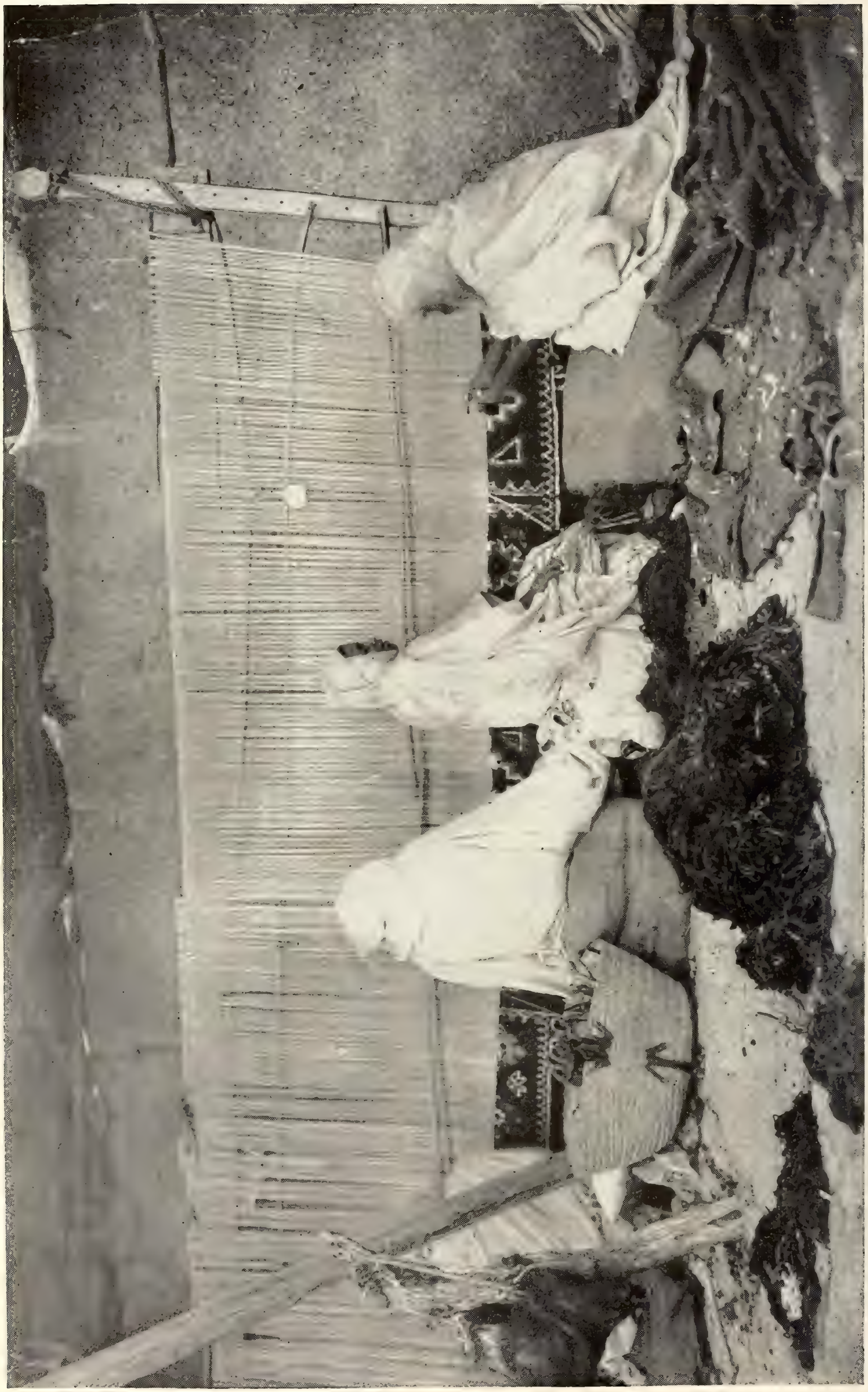
OUTLINE MAP OF THE SOUF COUNTRY

of this interesting race. For building material they are forced to depend upon the gypseous rock of the country and upon cement manufactured from it. Even the roofs are made of this substance, for in the Oued Souf date palms are too precious to be sacrificed for building purposes. Either because the material has not sufficient cohesion or because the architectural skill of the people is not equal to the construction of large arches, the roofs consist of rows of small flattened cupolas. Consequently, when seen from a distance, a village of the Souf looks like a cluster of drab-colored bee-hives.

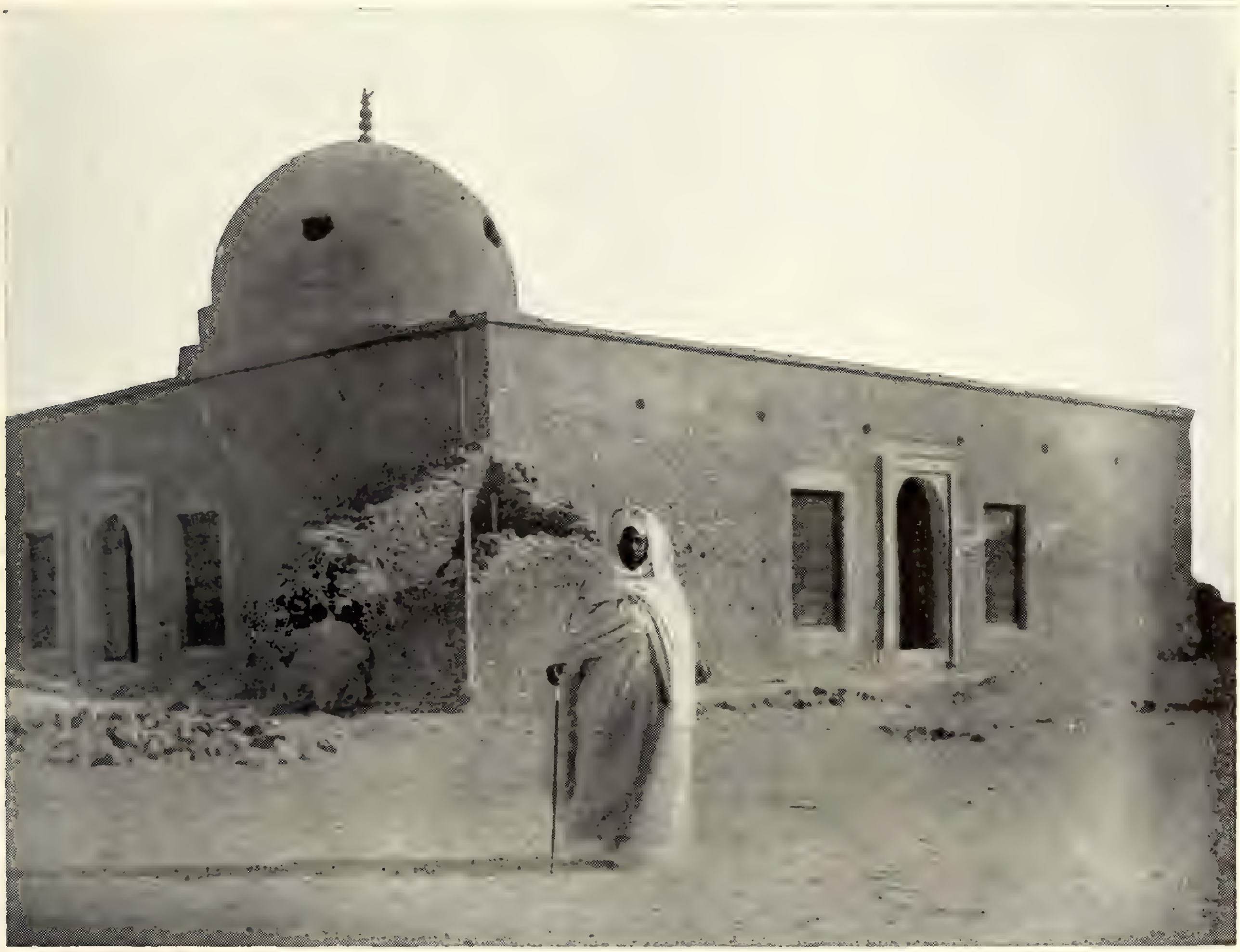
A feature of the towns which brings them into sharp contrast with the usual Arab village is their extraordinary cleanliness. Sand, the great purifier, is continually drifting among the houses, hiding with its mantle of charity the refuse that offends the traveler's senses in most North African towns.

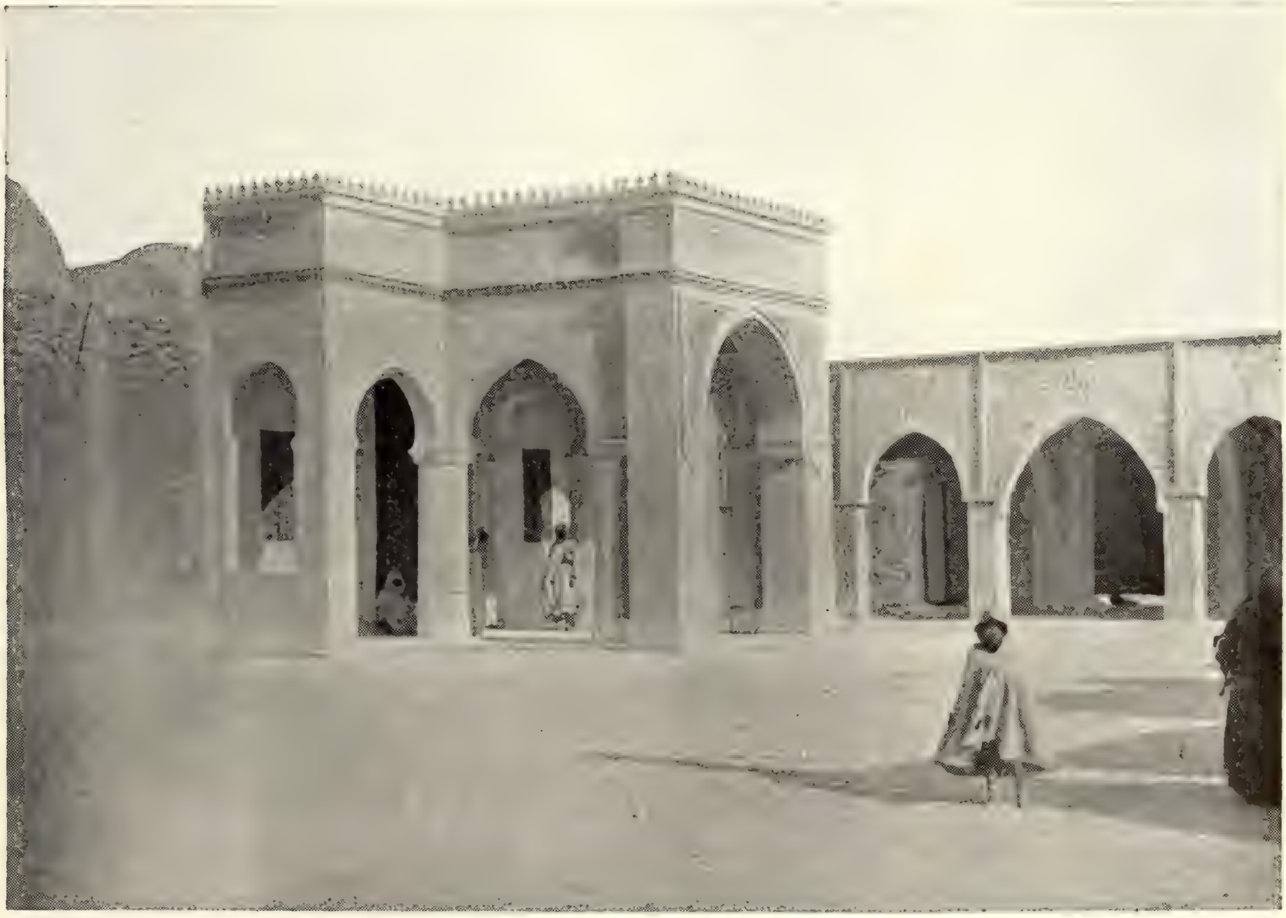
El Oued, the capital, numbers about 5,000 people, or one-fifth of the total population of the region. It contains few curiosities. Apart from a large mosque, the most conspicuous structures are steel wind-mills of American manufacture. The names of the streets are announced by neat blue-and-white placards at the corners. One notices that celebrated African explorers have been commemorated in such names as "Rue Duveyrier," "Place Flatters," etc. The district is administered by French army officers of the "Bureau Indigène," under whose supervision two caïds mete out justice to the natives.

One of the most interesting episodes of my sojourn in the Oued Souf was a visit to El Amiche, a village situated a few miles south of El Oued. Here I was entertained at luncheon by the marabout, a highly venerated leader of the "Khadraya" sect of Mohammedans. The holy man served me with his own hands



"IN A SHED BEHIND THE MARABOUT'S HOUSE A NUMBER OF WEAVERS WERE SQUATTED BEFORE A LOOM OF PRIMITIVE CONSTRUCTION, MAKING A CARPET FOR THE MOSQUE"





MARABOUT OF EL AMICHE, AND THE MOSQUE OF WHICH HE IS CUSTODIAN

HOUSE OF THE MARABOUT'S SON, EL GUEMAR

"The only dwelling of a native I have seen in the Sahara which could make any pretension to architectural merit"

"WHEN SEEN FROM A DISTANCE A VILLAGE OF THE SOUF LOOKS LIKE A CLUSTER OF DRAB-COLORED BEEHIVES" and was so profuse with his complimentary speeches that I found it difficult, through the medium of my interpreter, to keep pace with him.

The meal was a plentiful one, better cooked and served than is customary among the natives. Nearly all the dishes were highly seasoned with red pepper. The *pièce de rèsistance* was, as usual, the celebrated cous-cous. The foundation of this dish was semolina, cooked so that every grain was dry and distinct. It was served in a wooden bowl with a ragout of meat, carrots, tomatoes, chick-peas, and dried apricots. The fried dishes were cooked with goat's fat, the provision of the Mohammedan law against eating swine's flesh preventing the use of ordinary lard. The bread, baked in round, hollow loaves with a very thin crust, was chiefly remarkable for its extreme toughness.

The repast ended with several cups of thick black Moorish coffee, boiled with sugar. A glass of lukewarm tea as a sort of "chaser" after each cup was an innovation which I did not particularly relish, but when one is entertained by a host of such sanctity, it is out of the question to refuse anything that is offered.

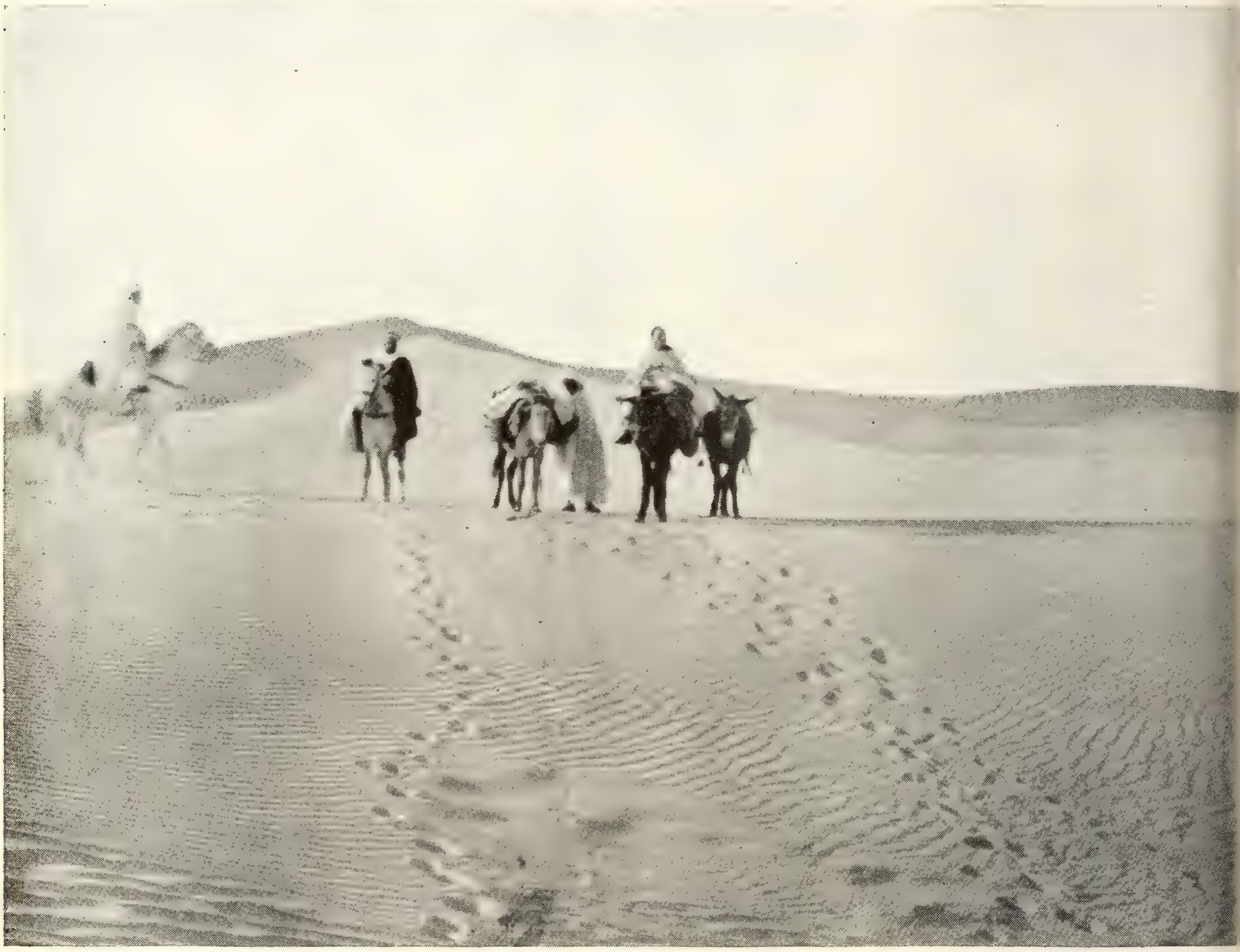
The marabout showed me with great pride a silver coffee service presented to him by a former governor general of Algeria. This was a reward for his services in bringing about the capture of the Touareg murderers of the Marquis de Morès, a young Frenchman who a few years before had made an ill-advised attempt to cross the Sahara with only a few Arab servants. I was told that in cases of this kind it is not unusual for the Algerian government to avail itself of the influence which the great marabouts possess among the wild tribes of the desert.

In a shed behind the marabout's house a number of weavers were squatting before a loom of primitive construction making a carpet for the near-by mosque, of which the marabout is custodian. The colors were gaudy and the pattern rude, yet not unpleasing.

Next day I rode to El Guemar, ten miles north of El Oued, and the second largest town in the Souf. It was market day at El Oued, and we passed crowds of men and boys driving laden camels and the sturdy little mouse-colored donkeys for which the country is noted. When I reached El Guemar I was immediately surrounded by a struggling, clamoring mob, whose behavior puzzled me until I learned that I had been mistaken for a purchasing agent of the Tunisian tobacco monopoly. Tobacco-growing is forbidden in Tunis and the government obtains its supplies largely in Algeria. We had noticed along the road as we came from El Oued many small irrigated patches of this crop.

There is another marabout at El Guemar, and my interpreter, who was always seized with a fit of devotion when in the neighborhood of one of these holy men, was anxious that I should make him a visit; but, remembering the rather formidable ceremonies of the day before, I declined the invitation and contented myself with a view of the house of the marabout's son. This had an attractive exterior and was the only dwelling of a native I have seen in the Sahara which could make any pretension to architectural merit.

The morning had been fine and sunny, but the weather was very disagreeable during our ride back to El Oued. The sky was overcast and a raw wind blew, at one moment filling our eyes with sand and the next driving gusts of cold rain into our faces. The woolen burnous which I had had made at Tozer a few days before proved very comfortable, although when riding I could never get the Arab trick of keeping its folds wrapped closely about the body while leaving both hands free to manage bridle and whip. The burnous is a very simple garment, with neither sleeves nor buttons. In fact it is hardly more than a blanket, gathered at one corner by means of a few curiously embroidered stitches, with a hole to pass the head through and a hood,



"THE LAST HOUR OF MY SOJOURN IN THE SOUF COUNTRY WAS SPENT AMONG THE TITANIC DUNES NEAR DEBILLA"

which is allowed to hang at the back when not needed as a head covering.

Following the advice of the French commandant at El Oued, we lessened the fatigue of the return journey to the Jerid by spending a night at Debilla, an outlying village of the Souf. The young sheikh of Debilla rode with us as far as his bailiwick. He was an exceptionally intelligent and fine-looking Arab. His costume, which did full justice to his handsome face and figure, consisted of a richly embroidered white silk haik and a snowy burnous of the finest wool. Mounted on a superb gray horse that seemed proudly conscious of the red and gilt of its trappings, he realized to the full the gallant cavalier of the desert who figures in the dreams of every school-boy reader of "The Talisman."

The last daylight hour of my sojourn in the Souf country was fittingly spent among the titanic dunes near Debilla—huge masses of pure sand, without stick or stone to mar their spotless surface. As the rays of the declining sun fell upon them, one could fancy that a sea of molten gold, lashed into fury by a hurricane, had been cooled and fixed before the billows subsided.

RECENT GEOGRAPHIC ADVANCES, ESPECIALLY IN AFRICA

By Major General A. W. Greely, U. S. Army

WITH the reasonable assurance that the Arctic Pole is surrounded by a deep, extended sea, and with the knowledge that its Antarctic antipodes is in practically the center of the greatest land-mass of the world, it is obvious that man's persistent activity has outlined the general contours of all seas and continents. It thus follows that the heroic phase of geographic exploration has passed for all time, and that men eager for recognition turned some time since their energies to researches which promise either scientific results or commercial advantages.

In considering geographic advances, it is pertinent, and perhaps not devoid of popular interest, to present the base-maps of modern geography. As novel to many, there is (p. 388) reproduced a map of the world, drawn from a catalogue of J. W. Hiersemann, Leipzig. It is from Francesco Berlinghieri's Italian Geography, *Geographia in terza rima et lingua toscana,* Florence, 1478-'80, probably the second oldest of printed atlases. Berlinghieri naturally continued Ptolemy's error of undercalculating by one-third the distance between Europe and the east coast of Asia, and it may well be that this very map from a home atlas encouraged Columbus in believing the unexplored distance to be navigable.

As illustrative of the vast advances in geography during the following half century after the voyage of Columbus, there is also reproduced the new world-chart, *Universale Novo,* from the work of Pietro Andrea Mattiolo, *La Geografia di Claudio Ptolemeo Alesandrino* (with additions by Sebastian Munster and Jacob Gastaldo), Venice, 1548. Although Magellan had circumnavigated the world, Asia, Europe, and America (as yet unnamed) are herein charted as one unbroken land-mass. These maps of four centuries since furnish means for interesting comparisons with the surface of the world as we know it today (p. 389).

DISCOVERIES OF NEW LANDS

Man's success in the explorative conquest of the world is forcibly illustrated by the statement in a leading editorial that the year 1910 had been quite devoid of actual geographic achievement, there being one notable addition only—the Antarctic discoveries of Charcot. Of all men, Dr. Charcot takes a broader view of geographic science and is unwilling to measure its progress by mere additions of hitherto unknown surface areas of the earth, welcome as such knowledge is.

It will be remembered that Charcot in 1905 by discovery extended Palmer (or Graham) Land southwest to Loubet Land, 67° south, 71° west. His expedition of 1909-'10 was specially fitted for scientific research in botany, geology, glaciology, hydrology, magnetism, meteorology, and oceanography. Reaching in the *Pourquoi Pas?* his farthest point of 1905, Charcot successfully worked his ship through the ice to the southwest, and, reaching the hitherto unvisited Adelaide Island (Biscoe, 1832), accurately located its position. It is an island 70 miles long, not a mere islet of less than 10 miles, as previously reported. Continuing his running survey, Charcot found that Alexander I Land (Bellingshausen, 1821) is a continuation of Palmer Land, indented by a vast gulf along whose glacier-lined shores he traced 120 miles of new land. Altogether the new discoveries extend the local southing from 65° 30′ to 68° 45′ south, and traverse a previously unknown sea between 104° and 128° west, save only as intersected at 108° west by Cook in 1774. Charcot's discoveries have an especially important bearing on the boundary of the great continent Antarctica, whose now recognized existence is due to the discoveries of Palmer, Bellingshausen, Wilkes, D'Urville, Ross, Enderby, Drygalski, Bruce, Nordenskiöld, Scott, Charcot, and Shackleton. Of Charcot's work M. Charles Rabot justly says, "It is one of the most fruitful in scientific results of any recent polar expedition not having the pole as its object."

EXPLORATIONS OF THE TWENTIETH CENTURY

The most important subjects of geographic research and exploration pertain, however, to the habitable earth and bear practically on their utilitarian relations to the activities of mankind. In his scholarly annual address to the American Historical Association, its president, Prof. F. J. Turner, while pointing out that the geographer is an allied laborer in historical study, added: "Historians must deal with the connection of geography with industrial growth, politics, and government. . . . Changing geographic factors . . . must be considered if we would understand the bearing of legislation and policy." This statement conforms to the generally accepted idea that the science of geography covers not alone the physical aspects of the earth—animal, mineral, and vegetable—but more particularly includes the interrelations of man with his material environment.

IMPORTANT FIELDS OF ADVANCE

It is pertinent to determine the phases and locate the fields towards which research is most persistently devoted. An examination of the publications for a year of the two great foreign societies, the *Royal Geographical Society* and the *Société de Géographie,* disclose that in the former one-third of the leading articles and in the latter one-half pertained to Africa. The character and extent of geographic work of importance are most clearly indicated by the proceedings of the Société de Géographie, which, without derogating from the special merits of other societies, may be said to take the broadest and most laudable activity in fostering and recognizing geographic research. In 1910 it awarded no less than 27 prizes, consisting largely of medals, though often supplemented by money grants. Nine awards were made for work in Africa, six relative to Asia, three to France, three to the Western Hemisphere, three for technical work, two to oceanography, and one for Antarctica. Nineteen awards were for researches pertaining to human relations, or bearing on natural resources, while one only was connected with the discovery of new lands. In its award to Shackleton the committee, recognizing the evolution of modern research, said pertinently: "Far from being simply a wonderful tour-de-force of physical vigor, it was especially and above all fruitful in scientific results of the highest importance." With Gallic liberality, two awards were made to aliens—Sir Ernest Shackleton and Mr. Bailey Willis (of the National Geographic Society).

EARLY AFRICAN CARTOGRAPHY

Two of the African maps of Mattiolo, Venice, 1548, are herewith reproduced. *Africæ, Tabula IIII,* shows Africa as depicted by Ptolemy in the second century. It will recall to many the legends and tales of childhood through Caphos (Cepheus), the mythical king of Ethiopia; the man-killing elephants of the equatorial interior, and the mystical Mountains of the Moon (*Lunæ Montes*), which for so many centuries figured as the long-sought sources of the historic Nile. This second-century map of Ptolemy, it should be added, was nearer correct as to the Nile and the adjacent mountains than were the standard maps at the beginning of the nineteenth century (p. 390).

Africa, Nova Tabula, represents the continent after the recent circumnavigation by da Gama (p. 391). The new map enlarges the drainage basin of the Nile to include the greater part of the continent, introduced a score of mythical cities, and eliminates the beloved Mountains of the Moon. And thus stood, as

Photo from "The Heart of the Antarctic," by E. H. Shackleton

A SEAL DESTINED FOR THE LARDER: IN THE ANTARCTICS

a whole, geographical knowledge of the Dark Continent for three centuries, advancing only some 60 years since.

AFRICA OF THE TWENTIETH CENTURY

As bearing on geographic work, it should be borne in mind that Africa has been divided between European powers. The most important spheres of control, direct and indirect, in areas and in population are approximately as follows: France (including Morocco), area 45 per cent, population 24 per cent; Great Britain (including Egypt), 35 and 39 per cent; Germany, 9 and 12 per cent, and Belgium, 9 and 16 per cent. Actuated by political considerations and stimulated by the spirit of commercial expansion, the colonizing countries have pursued their researches so efficiently that today Africa is better known and more accurately charted than are extended areas of Asia and South America.

African explorations have been the outcome of private enterprise for commercial exploitation, under the auspices of geographic societies for the advancement of scientific knowledge, and through official parties for the development of the country. Prolific in results have been the labors of the many boundary commissions for deliminating the separate regions under European control. In Africa by wise prevision are prevented the international disputes similar to those which neglected boundaries have entailed so often on the continents of America.

FRENCH RESEARCHES

The most striking results are those accomplished by the unequalled energy of France in her steady advances towards the assimilation and domination of the northwestern half of the continent of Africa. Their commissions have not alone explored the unknown regions, but they have thoroughly investigated the commercial possibilities of the immense territories under their control. Their reports bear on the productivity of the

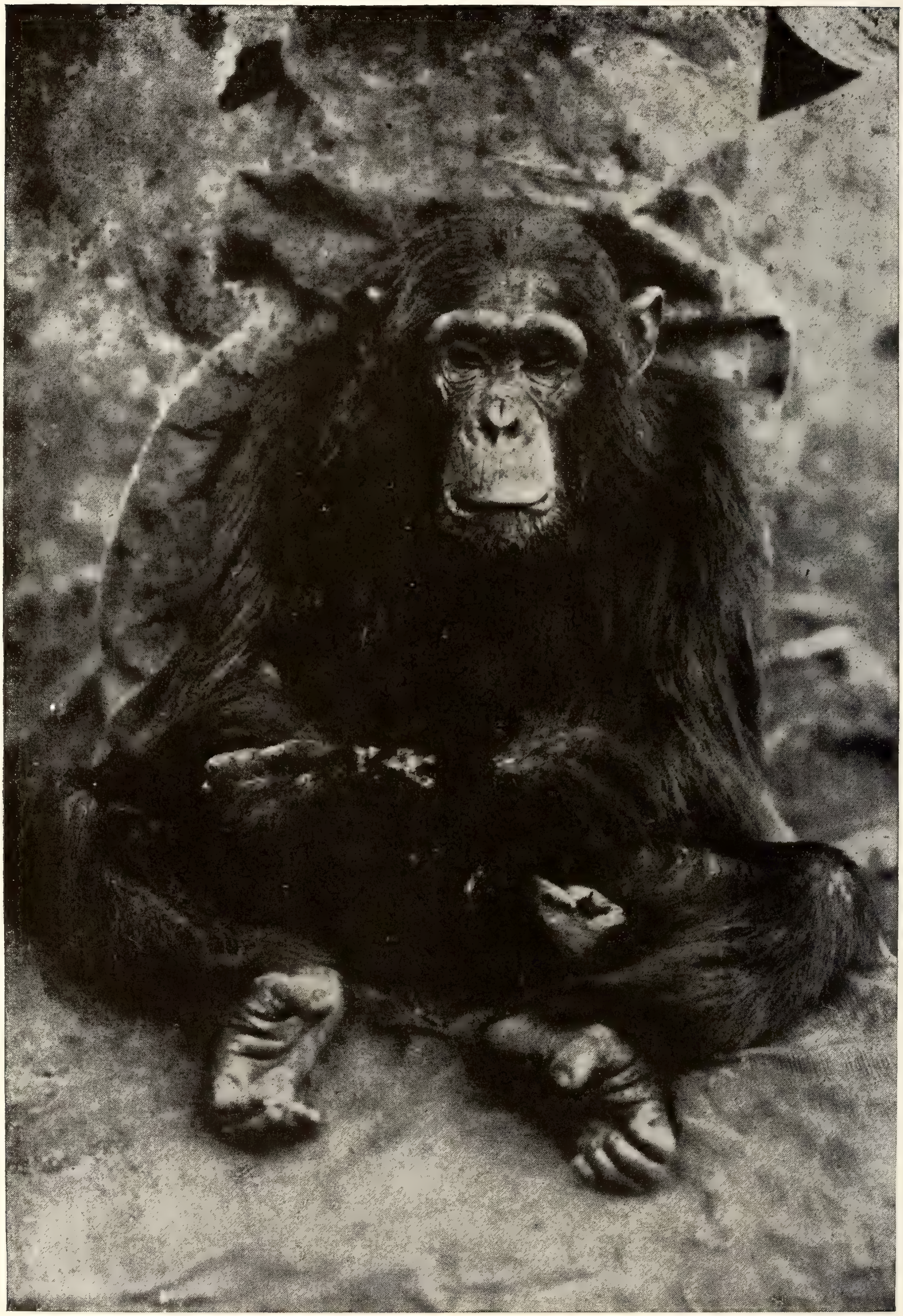


Photo from Sir Harry Johnston

A MALE CHIMPANZEE IN THE UGANDA

soil, the suitability of the climate, the existence and accessibility of forestal wealth, the presence and probable extent of mineral veins, and on transportation methods by road, river, or by rail. Equally valuable are their data on the social habits, tribal characteristics, centralizing conditions, and governmental methods of the millions of natives, on whose activities and stimulated wants must eventually depend the commercial development of Africa.

The French army has contributed largely to these valuable researches, and the views of its trained and selected officers are well expressed by General Lebon, who said of Africa: "Geography becomes a fairy godmother whose mission is to reveal to man for his highest good infinite and hitherto unutilized riches." The struggle of the army to insure safe travel across the Sahara was most bitter, as well as its work in Morocco, and there were in 1908-1909 in North Africa more than a hundred fights, with a French loss of several hundred in killed and wounded. Peace and order now prevail; the occupancy of the desert palm groves controls the nomads. Today at no point in the vast French Sudan is there seen more than a single company for police duty.

It should be known that the regions in Africa controlled by France exceed in extent by more than 50 per cent the area of the United States, and it is obvious that only the more important of its many recent explorations can be even mentioned in this brief summary.

THE SAHARA REGION

Though comparatively unfertile, the great Saharan Desert vastly influences the surrounding regions. France controls it by oasis guards, selected scouts of experience, called *méharistes,* well mounted on camels. This service, at an expense of $600,000 a year, is true economy. Under earlier conditions the Bilma trans-Saharan route was plundered to the amount of a million and a half dollars yearly, besides the enslavement of the natives there captured.

Great portions of the desert (the Saharan-Sudan region) have been charted through the geodetical work of French officers. Captain Cortier, the chief, states that a vast region 9 degrees in longitude and 12 degrees in latitude is sufficiently watered to produce grain (mil) from grass wherever the soil is not sand-invaded. He relates that the Touaregs habitually open the anthills and take therefrom the reserves of grain accumulated by the ants.

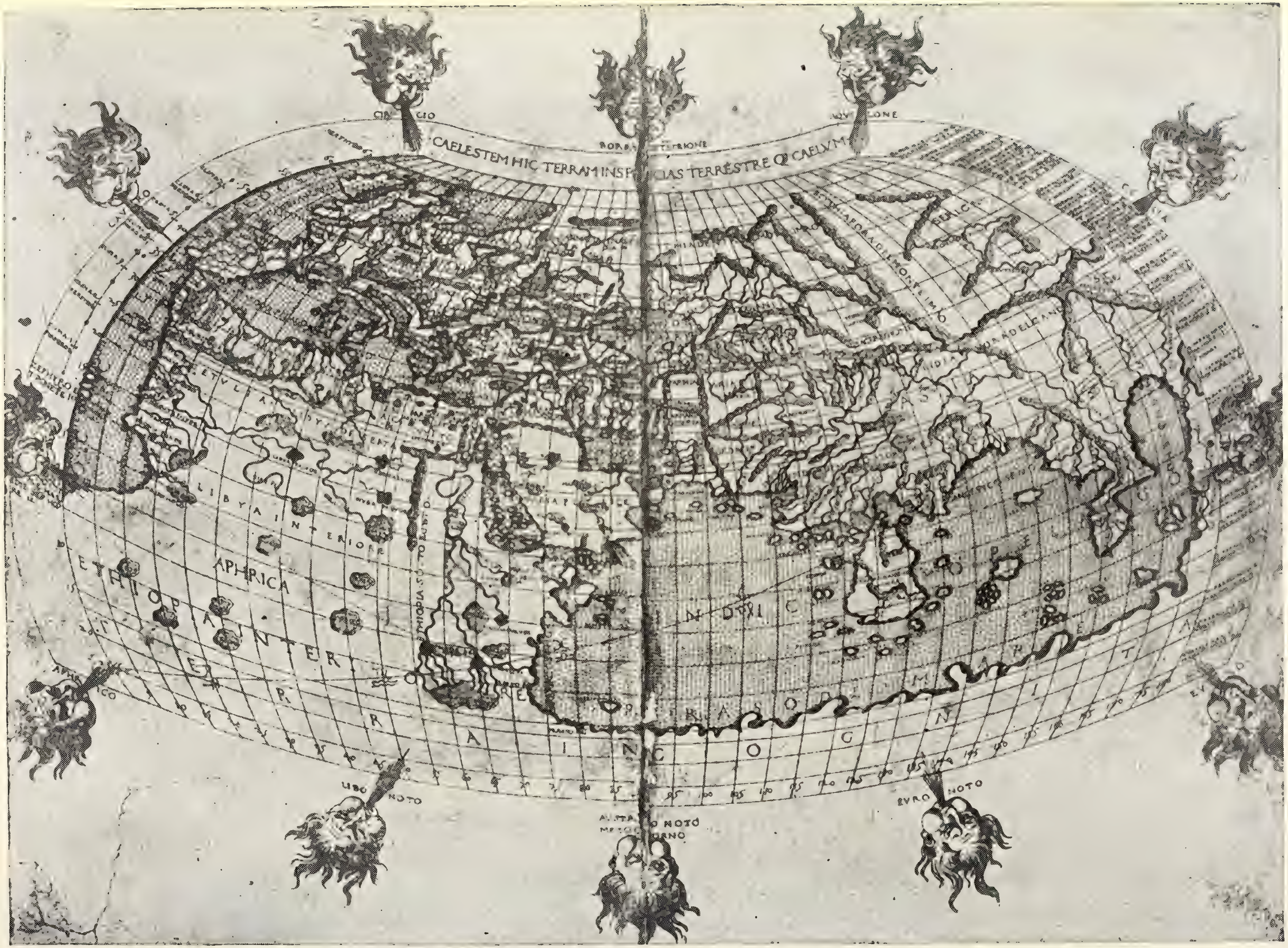
His description of Kauouer modifies our ideas of a Saharan oasis. Its 100,000 palm trees furnish subsistence for a dozen straggling villages, with their small flocks and scant crops of grain and vegetables. Adjacent desert routes are filled with long trains of slow-paced, heavily laden camels carrying the annual exports of the oasis—25,000 loads of salt and 5,000 of dates.

FRENCH KONGO

In connection with the Kongo-Kamerum boundary, Captain Périquet explored 500 miles of unknown routes, of which 300 were through dense woods. Railway surveys now progressing from Libreville to the Sanga River are through great forests, which are being actively exploited, the natives being tractable instead of hostile, as before reported. These surveys disclosed a high, rolling plateau, the lofty Crystal Mountains of that region being mythical.

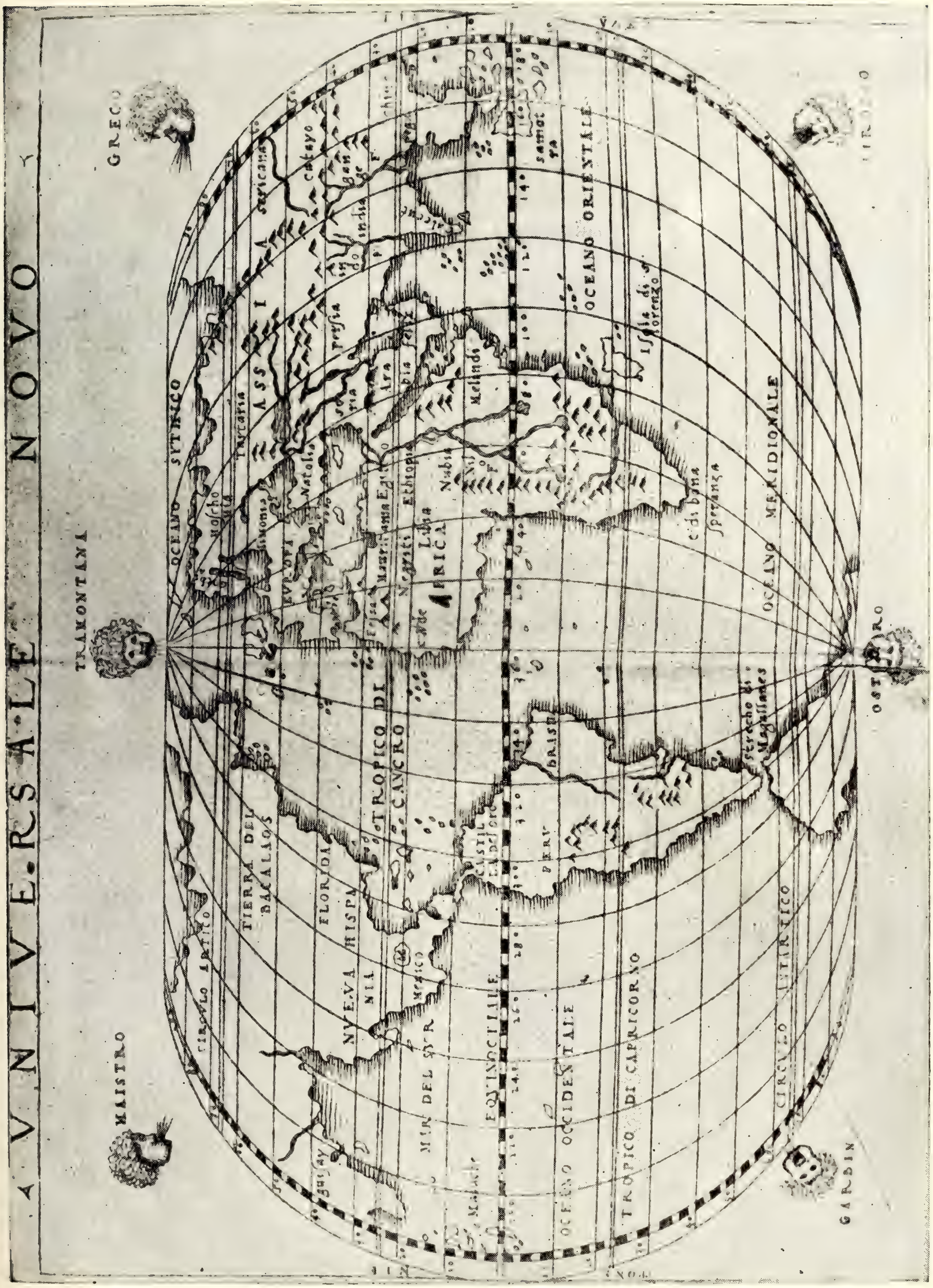
MOROCCO

Nominally independent and practically unknown, this country is gradually developing under the activity and influence of France, to whose sphere of influence it naturally trends by association and propinquity. Since 1904 M. Louis Gentil has annually investigated unknown areas of Morocco, studying its hydrology, locating its mineral wealth, and examining its forestal and agricultural zones. His maps are the first to adequately represent the physical conditions of the country. While mineral belts of prospective value are found, yet M. Gentil looks to the extremely fertile soil belts as insuring the prosperity of Morocco, fitted as they



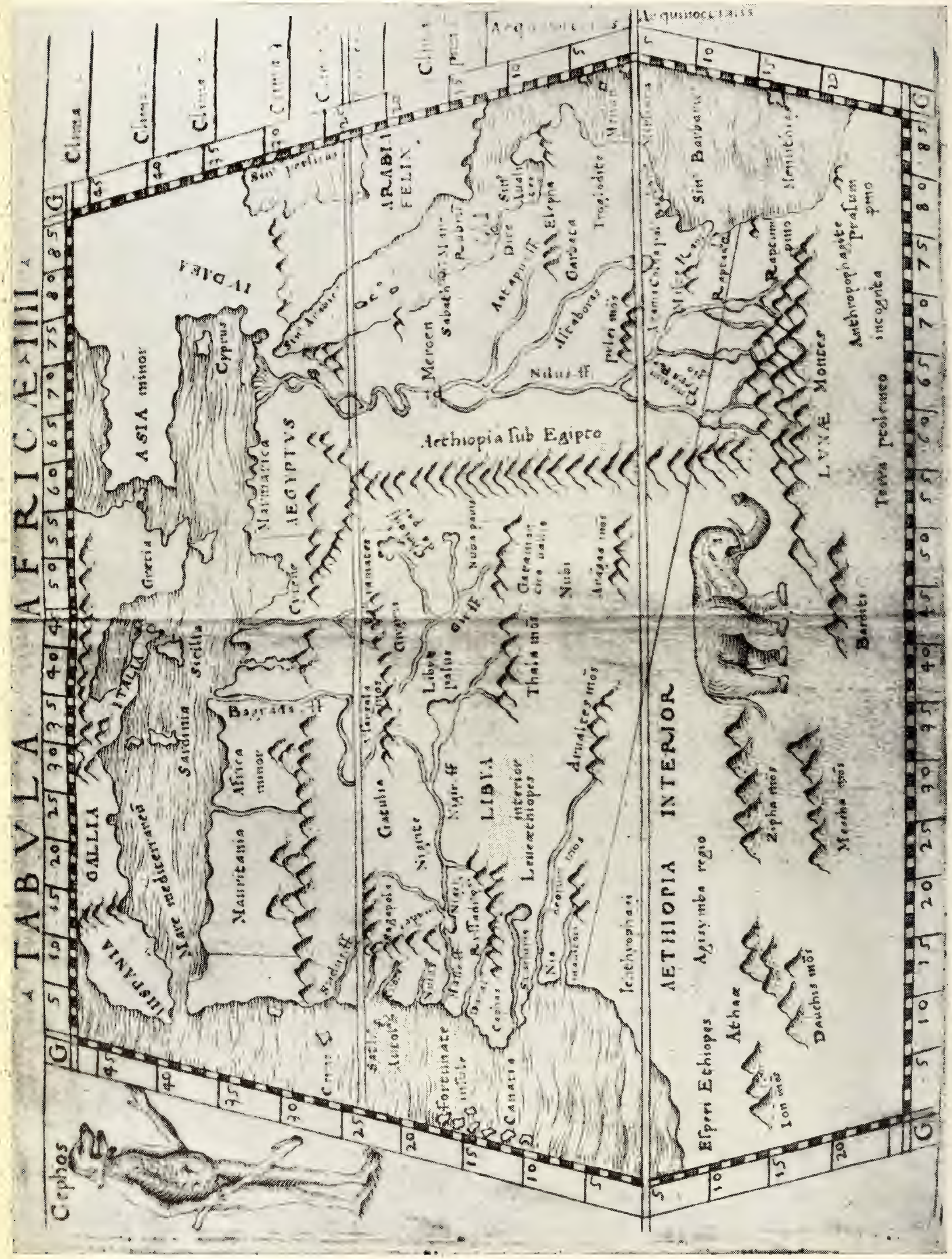
THE SECOND OLDEST MAP OF THE WORLD: BY BERLINGHIERI, BEFORE COLUMBUS (SEE PAGE 383)

Probably this is the map which set Columbus to work. It was printed in Florence, near enough for him to see it



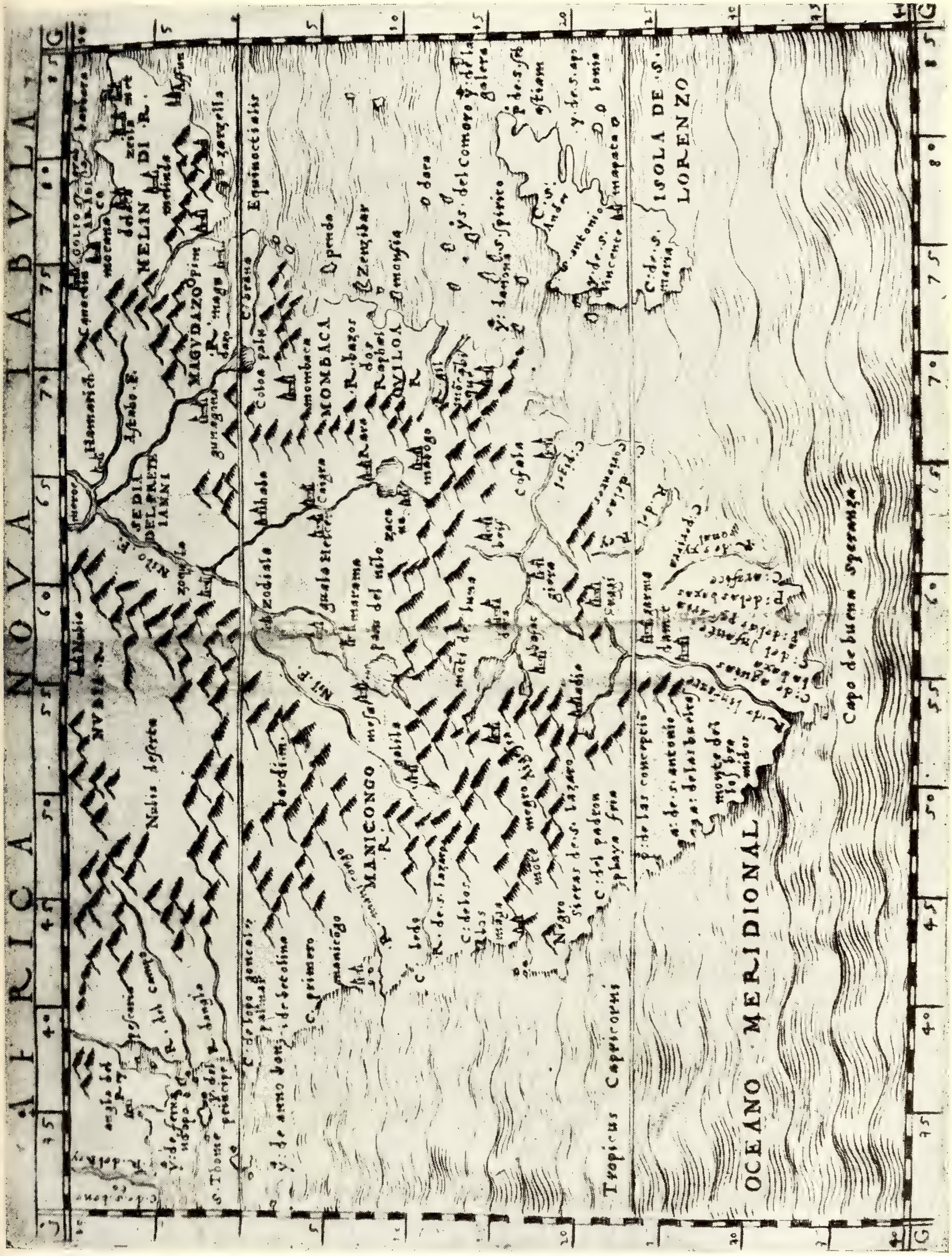
THE WORLD-CHART: BY MATTIOLO, 1548

Although Magellan had circumnavigated the world 26 years before, Asia, Europe, and America were still charted as one unbroken land-mass (see page 383)



MAP OF AFRICA, AS DESCRIBED BY PTOLEMY IN THE SECOND CENTURY: BY MATTIOLO: VENICE, 1548

This map was more nearly correct as to the Nile and adjacent mountains than were the standard maps of Africa, published at the beginning of the nineteenth century (see page 384)



FROM THE NEW MAP OF AFRICA, WITH DA GAMMA'S DISCOVERIES, 1498: BY MATTIOLO, 1548 (SEE PAGE 384) are for forestal and agricultural products.

COLONIES OF THE WEST COAST

The watershed of the Niger and the adjoining Atlantic areas have largely engaged attention through their fertility and trade possibilities. The railway from Guinea to Conakry, owned by the West French African government, has been built, thus connecting the upper Niger with the ocean. Its average cost per mile was $32,000, and 5 million dollars were paid the natives for construction work. The availability of local labor is shown by the 12,000 natives working on the road in 1909. Its economic value to the country is evidenced by the steadily increasing freight, which has raised the net income per mile from $200 in 1906 to $1,240 in 1909.

M. Hubert explored geologically the Siguiri and adjacent regions through 60 square degrees, and maps now cover geologically 400,000 square kilometers. M. Aug. Chevalier, 1908-1910, investigated the Atlantic coast colonies, the flora, agricultural factors, and forestal resources of Guinea receiving close attention. The Ivory Coast proves especially rich in rubber along the Liberian boundary. In Dahomey a region mapped as a marsh proves to be a dry, well-wooded plain. The explorations of Captain Gross disclose the existence on the Ivory Coast of valuable forests of an area of about 8 million hectares and the existence therein of 58 kinds of useful woods. There is no tribal organization, but the government is by family. Labor is available under just and humane conditions, so that the forests can be economically exploited. The dreaded local climate proves susceptible to hygienic improvement. Fourn's surveys in Dahomey, Ringenbach's investigation of the sleeping sickness, Gironcourt's explorations of the bend of the Niger, and Zeltner's work in the Sudan are worthy of note, but space lacks.

THE CHAD REGION

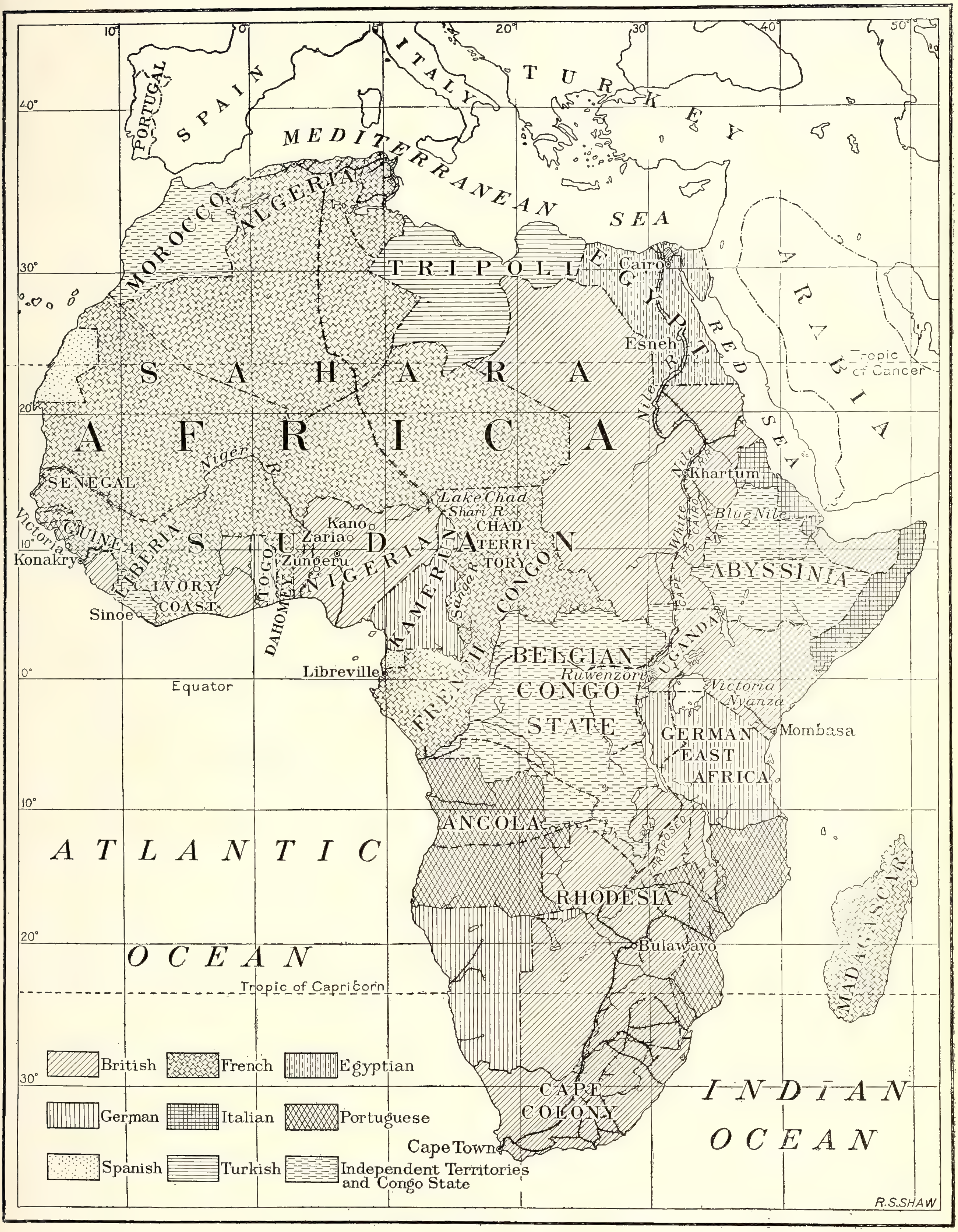
Of all narratives of missions, that of Capt. Jean Tilho, 1907-'09, in surveying the Niger-Chad boundary most appeals to the imagination through the vast and strange country it concerns. The region was opened by France in 1901, when her troops defeated the cruel negro tyrant, Rabah, the pest of the terror-stricken tribes. The country is an interior drainage basin, like our own Salt Lake Valley, of enormous extent—about three times the area of France. French methods have brought about order and prosperity, 50 *méharistes* today keeping peace among the various tribes along a border of several hundred miles.

Scientific explorations disclosing its resources, the Chad basin was amicably divided between England, France, and Germany. Tilho's boundary work was supplemented by extended researches between 12° to 17° north, and from 0° to 15° east (Paris). His survey included 400 astronomical positions and involved 25,000 miles travel. Valuable collections and observations were made in ethnology, magnetism, geology, and natural history.

WOOD WHICH IS LIGHTER THAN CORK

Especially interesting are the strange ambach (*Hermininiera elaphioxylon*) forests, growing in the waters of Lake Chad to 25 feet in height and 12 inches in diameter. This curious tropical tree grows only in water of moderate depth and so rapidly that it attains its full height in two years. The wood when dried is the lightest in the world, its density being only 40 per cent that of cork.

The most interesting feature is Lake Chad, in the center of this vast country, 2,000 miles distant from the ocean at Senegal and 1,200 miles from the Nile. While its maximum area of 10,000 square miles slightly exceeds that of Lake Erie, Chad is noted as being the shallowest lake of the world, its average depth being less than six feet. Fed by local rainfall and by three contributing streams (practically all water coming from Shari River), it loses about four feet annually by evaporation. In 1908 it was but one-fourth its maximum size, owing to suc-



OUTLINE MAP OF AFRICA, SHOWING POSSESSIONS OF EACH EUROPEAN POWER

OULED NAIL DANCING GIRLS

Photo by Bougault, Biskra. From "The Desert Gateway," by S. H. Leeder. Cassell & Co. Mr. Leeder's book is a fascinating and very sympathetic account of the Arab denizens of the great desert.

cessive years of drought. With rapid shrinking, fish perish by millions, cattle die, large game migrate, and tribes abandon the resultant salt marshes. Much of interest was gained relative to the natives, the Boudaman tribes to the south being agricultural and peaceful, while those to the north were pastoral and warlike.

BRITISH ACTIVITIES

Much the greater proportion of civilized peoples in Africa being under English control, British activities have naturally turned towards vital problems of finance, administration, and government. These questions assume extreme importance from their practical bearing on trade, commerce, and transportation, on which factors the future prosperity of Africa depends.

Though subordinated to these special activities, British explorations have, nevertheless, been fruitful, especially in connection with the eight boundary commissions, which have penetrated many unexplored regions, thus adding wealth of knowledge as to various tribes and their environment. Major Whitlock traced the Nigerian frontier 300 miles, surveying large areas under adverse conditions of hostility, which entailed severe losses in killed and wounded. Commander Whitehouse distinguished himself by an admirable survey of Victoria Nyanza and Ommanney through his astronomical work in Nigeria. In addition to the Uganda-Kongo surveys, Major Bright explored the Ruwenzori Mountains and measured through that locality a section of the great meridian arc along 30° east.

Sir Harry Johnston, known in the NATIONAL GEOGRAPHIC MAGAZINE, has made studies of Uganda and around the equatorial lakes which stand scarcely second to any similar African researches. Fishbourne's surveys for the Uganda Railway were prolific in results, and Lieut. Boyd Alexander's transcontinental journey through the dense, tangled forests between the Niger and the Nile recalls the thrilling experiences of that great traveler, Stanley Africanus, 30 years earlier.

"UN SOU, M'SIEUR?" A BEAUTIFUL LITTLE BEGGAR GIRL

From "The Desert Gateway," by S. H. Leeder. Cassell & Co.

Of intense human interest are the ethnological studies of the many primitive peoples, whose individuality is vanishing under advancing civilization. Torday tells us of the people of the Kasai basin; of the Baboma women, with elaborately cicatrized faces, set off with brass neck-rings of 30 pounds weight; of the alert, skilled pigmy hunters; of industrious Misambu, where, wonder of wonders for Africa, every one works, carving, forging, weaving; and of the high forms of a pure African art apparent in the carvings and textile industries of these natives.

Perchance more fascinating are the researches of Talbot, sometime resident among the Ekoi of South Nigeria. A high-typed race, given to dance and woodland mysteries, they are survivals of Pan. The sacred Egbo (men's) and Nimm (women's) clubs are as inviolate to each sex, under penalty of death, as in the dawn of mythology. Among the sweet, quaint superstitions of the devoted Ekoi parents is one which forbids quarreling in a household of little children, who in their reincarnated state love gentle voices, smiling looks, and winning words.

CAPE TO CAIRO RAILROAD

Exploration and research induced trade and annexation, which in turn entailed colonization and governmental responsi-

A FALCONER

Photo by Bougault, Biskra. From "The Desert Gateway," by S. H. Leeder. Cassell & Co.

bilities. The formation of the South African Confederation and the occupation of Egypt have taxed British energy and resources to the utmost, and in their development transportation facilities were deemed of the highest importance.

The South African railway systems now aggregate 6,000 miles, with 2,000 miles more in prospect. Time and money are gradually transforming into reality the dream of a Cape to Cairo Railway. In operation last year from the Cape to Victoria Falls, 1,640 miles, it is built to the German frontier. This section attains its maximum altitude of 4,850 feet near Bulawayo, having followed the crest of the watershed from a point a thousand miles to the south. From Cairo the railway extends to Rahab, 13° 8′ north, on the White Nile, 200 miles south of Khartum. With the Uganda Railway extending 600 miles inland from Mombasa, the east coast is well provided with modern transportation.

NORTH AND SOUTH NIGERIAS

Perhaps English advances have been proportionately greater in the Nigerias than elsewhere, their 13 millions of natives affording a broad field. They accept transition well, in general, and have been largely utilized in railway and other construction work. The road from Boero, the navigable head of the Niger, to Zungeru and Zaira, is under extension to Kano. Steamboats on the Niger, well-kept roads, 4,000 miles of telegraph and telephone lines are transforming this part of central Africa. Technical schools and church missions are doing their part in modifying the habits of the people.

HYDROLOGICAL SURVEYS IN EGYPT

Important as have been the financial reforms and advantageous as are the transportation facilities afforded by British rule in Egypt, they yield in permanent value to the assured benefits of the surveys for conserving and extending the water supply of the watershed of the Nile. The regimen of the Blue and the White Nile has been thoroughly studied and the hydrological conditions accurately determined. As supplementary to the conservative methods now in operation, the accumulated data indicate that Egypt must turn to the annexed Sudan, with its millions of square miles of contributory watershed, for additional supplies. As is known, the great Assuan dam insures timely water supplies for the midsummer crops of lower Egypt, and its increased height has enlarged the irrigated sections by an area larger than that of the State of Rhode Island. An added regulating dam at Esna, upper Egypt, brings under cultivation waste land equal in area to Connecticut. The solution of the *sudd* (compact vegetation masses choking the river channels) problem in southern Sudan will largely increase the water from the equatorial lakes.

Captain Lyons, in Egypt, and Colonel Taylor, and successors, in the Sudan. have run a practically unbroken line of levels from the Mediterranean to Lake Victoria, 3,500 miles. Sudan surveys show the whole region on a scale of 1 : 250,000 with a fair accuracy.

KHARTUM AND THE SUDAN

Signs of changed conditions are nowhere more strikingly evident in the Sudan than in the transformation of the place of Gordon's murder. The collection of wretched huts, under dominion of a religious fanatic, has given way to a modern city, the center of peaceful justice, religious tolerance, thriving trade, and technical education. A city of 40,000, Khartum is the seat of government, a center of Coptic Christianity, is within nine days of London, and in touch with the world by railway, telegraph, and steamer. The demoralizing slave trade has forever vanished, peaceful trade conditions exist, and the environs, the most densely inhabited parts of the Sudan, are becoming prosperous through advanced opportunities and improvements in agriculture.

Its most distinctive advance was the establishment of Gordon Memorial College, the recognized center of modern education and scientific research for two millions of natives. It trains native youth for teaching or for the law, teaches the arts of surveying or engineering, and opens up a new world to the ambitious natives. American interest attaches to this college, owing to the endowment of its research laboratories by one of our well-known generous citizens, Henry S. Wellcome. Through the laboratories, pathological and economic researches have been made along the Nile and its tributaries for a thousand miles to the south of Khartum.

THE BELGIAN KONGO

The activities of Belgium have continued along lines of extreme commercial exploitation, which have given rise to commentaries, especially in connection with the main product, rubber. Whatever may have been past conditions, improvements are promised for the future in the way of opening up government land, equalizing taxes, and restricting application of punishments. Four hundred miles of railway and fleets of steamers afford transportation, which will soon be supplemented by suitable extensions by rail.

Perhaps the most extended research work has been in connection with Captain Newcombe's surveys for a railway from the upper Kongo to the watershed of the Nile. The railway levels from the Atlantic vary less than 60 feet at the intersection with the levels from the Indian Ocean.

GERMAN COLONIES

With national systematic methods, German officials have gathered data bearing on the resources of their colonies, which possibly lack financial aid from the government to the extent it has been granted by other nations. Diamond-mining and cotton-growing are recent developments of the colonies of the west coast.

It is interesting to note that the best atlas of Africa comes, not from a German source, whence it would be expected, but from an Italian, Signor Ghisleri.

German East Africa is a model German colony. Peace and order prevail, and education receives particular attention. The government has thousands of pupils in its schools, which are specially devoted to handicrafts. Many missionary societies devote their energies to the improvement of the people. It is doubtful if elsewhere in Africa there is such close attention to the individual native, and apparently with good results. There are many wide, well-kept roads, and though there has not been great railway development, the telegraph is largely installed.

LIBERIA

Americans are interested in Liberia, where after 90 years the hinterland is unknown. Light is thrown on it through the French-Liberian boundary commission of 1907. M. Moret (French) crossed Liberia from Gribo, 6° 21′ north, 15° west, to Sinoe. The hundred miles of unknown country thus traversed is covered with dense forests of rubber and palm. The few unwarlike, inactive natives eat only once a day, subsisting principally on palm nuts. Inland are rare patches of rice or beans, but toward the coast sugar-cane, bananas, etc., appear. Animals were seen but rarely.

The natives practice sorcery with African cruelty. They think that everything has a soul, and ascribe the singing of a lamp to its contentment with the oil.

Abyssinia as yet remains outside of any distinct European sphere, but time and circumstance will undoubtedly bring its warlike tribes to the normal African fate—exploitation by the white man.

AMERICAN POTASH FOR AMERICA

By Guy Elliott Mitchell

Of the United States Geological Survey

IN the great Stassfurt potash salt deposits Germany holds a world's monopoly of this precious fertilizing element. By a cleverly devised system of fixing quotas for all active mines and by imposing a heavy tax on all productions in excess of arbitrarily fixed quotas, the German Government has forced the United States to the full realization of this very embarrassing fact. The importance to the United States of developing an American potash industry to offset such a condition may be appreciated from the fact that last year we sent to Germany $12,000,000 for this mineral, peculiarly vital to every farmer in the land. Incidentally it may be remarked that the German deposits are practically inexhaustible, being estimated to contain, at the present rate of consumption, sufficient potash for the entire world for half a million years.

Tell the farmer that his supply of potash is endangered and it is like notifying the locomotive fireman that he will get no more coal, for potash is a necessary constituent of every bag of fertilizer which the farmer purchases when he drills in his wheat or rye or oats, when he plants his corn, his tobacco, or potatoes; in fact, every farm, fruit, and garden crop.

There are three elements necessary to plant growth, and potash is one of them. It is coequal with phosphorus and nitrogen, and every one of the 50 to 55 million sacks of fertilizer sold each year must carry a printed guarantee of the percentage of potash therein contained.

Germany is to some extent dependent upon our broad American acres for her food supply, but we are wholly dependent upon her for the continued production of a grain, fruit, and livestock surplus for export. Such a surplus is made possible only through soil stimulation by fertilizing.

The German attitude in this matter, while working an apparent immediate injury, cannot in reality prove other than a blessing in disguise to the United States. Without this agitation of the subject we would in all probability have continued for many years buying enormous quantities of potash salts, since the German deposits are almost inexhaustible. Now, however, our present helplessness has been demonstrated, and so we shall be compelled to develop our own latent potash resources until we are independent of any foreign supply.

EXPLORATIONS BY THE GEOLOGICAL SURVEY

It can be authoritatively stated that there is abundance of potash in the United States for present and future needs for fertilizing, for the manufacture of explosives, and for every other possible use.

Our potash possibilities will be developed along two distinct lines: exploration for potash salts and utilization of potash-rich rocks. It is believed that systematic searches for potash deposits, similar to those of Germany, will also lead to the discovery of beds of soda nitrate which may rival the great Chilean deposits. In 1910 our purchases of these two fertilizing materials—nitrate from Chile and potash from Germany—amounted to over $25,000,000. Within the next decade, at the present rate of increase in consumption, the figures will reach over $50,000,000 a year.

HOW THE POTASH MAY BE FOUND

Of great interest, therefore, are the preparations of the United States Geological Survey for the exploration for potash-salt deposits in the desert regions of the West. For this work Congress made a special appropriation of $20,000.

To understand how the geologists will search for potash, it will be well to consider the manner in which the German potash deposits were formed, bearing in mind the fact that ocean water contains considerable potash. Ochsenius, the

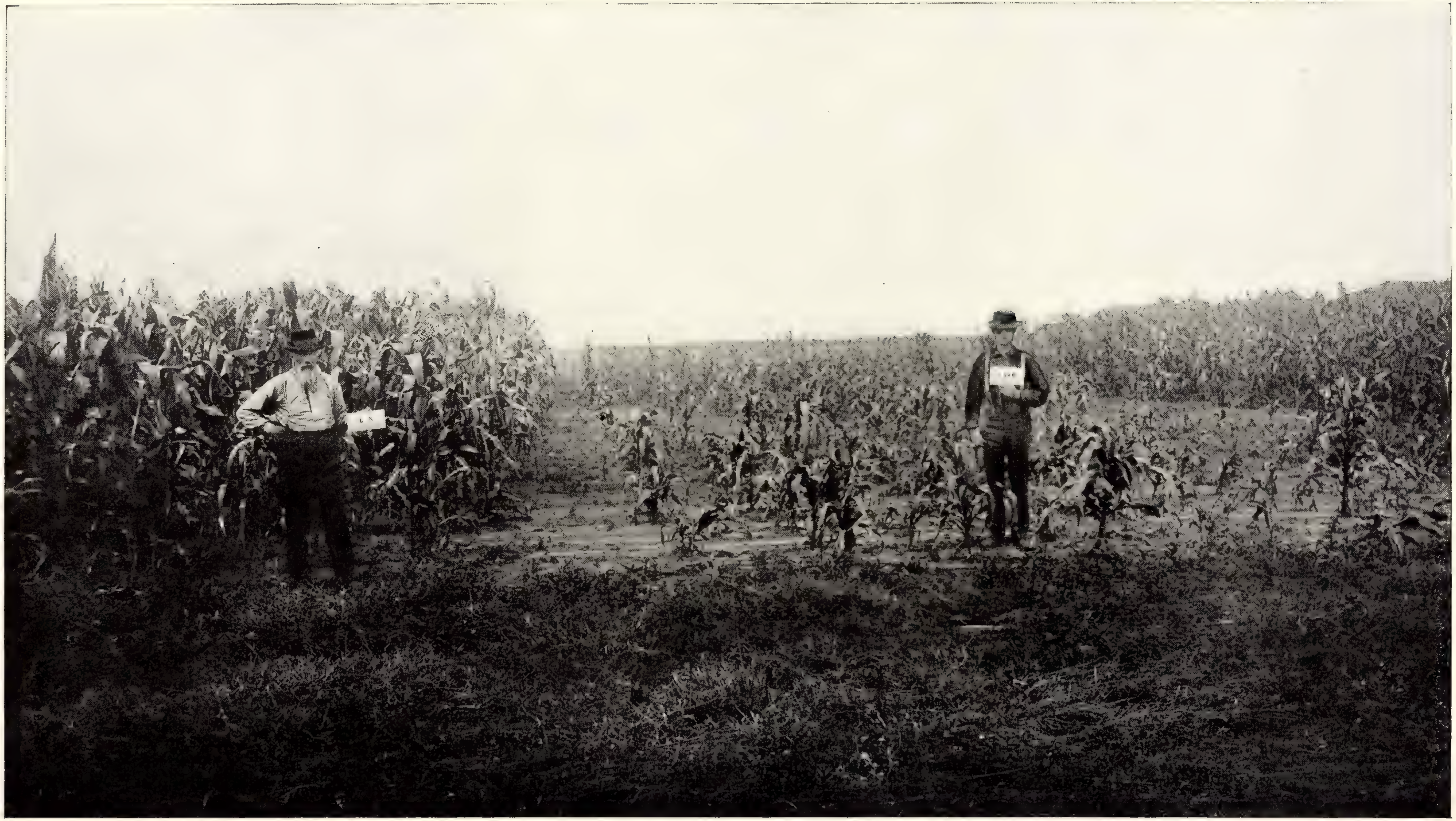


Photo from Illinois Agricultural Experiment Station

FIELD SHOWING THE VALUE OF POTASH TO THE FARMER

The soil is mucky and deficient in potash; the plat on the left has been enriched with potash, and yields a luxuriant crop. The center plat had no potash application, and the crop is scanty

German geologist, pictures, in the early ages of the world, an extensive and deep gulf or arm of the ocean, which later became land-locked, and the water of which gradually evaporated. The various substances in this concentrated sea water were deposited at the bottom of this lake, but the potash, being the most soluble, remained till the last, and was then laid down in a thick bed and deeply covered by strata of protective clay and other sediments.

Government geologists point to many sections in the West where the stratigraphic conditions are similar to those in Germany and most favorable for the existence of such potash beds. Potash is a constituent of all sea water, and the entire West was once covered by the ocean. As the land rose, it left immense salt-water lakes, containing billions of tons of potash, and these, during long geological periods, gradually evaporated. As a consequence the potash beds are there, beyond a doubt. The problem is to locate them.

The German potash mines are very deep, and it is expected that the American deposits also will be found far beneath the surface. To locate them will require deep drilling by means of rigs, such as are used in the oil fields. The search, however, will not be a hit-or-miss proposition. The Geological Survey will bring to bear its full knowledge of the geological structure of the arid region, and will carefully select the most promising of the areas known to have been covered by great prehistoric lakes.

For instance, in Utah there is an enormous ancient lake basin, of which the Great Salt Lake is the feeble remnant. This lake covered a large portion of the State of Utah, and its waters stood a thousand feet above the present shoreline of the Great Salt Lake. Its ancient beaches can be seen from the railroad train far up the mountain sides, above Salt Lake City. Another enormous lake, known geologically as Lake La Hontan, existed in Nevada. The potash contained in the waters of these great inland seas can only be estimated in countless millions of tons. Mono Lake, in California, a mere mill-pond by comparison, contains an estimated 10,000,000 tons of muriate of potash.

In some such prehistoric lake beds as those of Utah or Nevada, on the public lands, the Government geologists will decide upon sites for drilling, and if they do not strike potash soon it will be because the scope of their operations is necessarily restricted by the lack of money appropriated. It is hoped that success will crown the initial efforts. How the great find will be managed by the Government is an interesting question. The Government operates no mines; but having found the potash deposit it cannot well give it over to private interests to develop and probably monopolize. A great potash deposit, such as that of Germany, would have a potential value of billions of dollars. Probably the Government would have to retain title and lease the mines in the interest of the people.

MUCH POTASH IN GRANITE ROCK

Of scarcely less interest is the problem of the extraction of potash from rocks. Of the feldspathic rocks, including the granites, potash constitutes from 5 to 10 per cent and even higher percentages.

Among the igneous or volcanic rocks containing large amounts of potash, as described by W. C. Phalen,[*] are the glasses, of which the chief are obsidian, pumice, perlite, and pitchstone. In these rocks the potash may run as high as 5 or 6 per cent, or even considerably higher. The rhyolites are also rich in potash, commonly containing more than 5 per cent of potash, while a certain rhyolite from Silver Cliff, Colorado, has been shown to contain 8.38 per cent. The trachytes and phonolites are also well supplied with potash, some of these rocks containing nearly 8 per cent. The rocks of the Leucite Hills, Wyoming, described by Whitman Cross, of the United States Geological Survey, contain large percentages, certain of them carrying from 9.81 to 11.91 per cent of potash (K_2O). The greensand marls of New Jersey,

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[*] Potash Salts; Their Uses and Occurrence, in the United States, 1910. U. S. Geological Survey.

Photo by Walcott, U. S. Geological Survey

VIEW OF SALT FLAT, CLAYTON VALLEY, NEVADA

Many such prehistoric lake beds are scattered throughout the Great Basin region, whose depths may be sources of vast potash deposits

Photo by Whitman Cross, U. S. Geological Survey

NORTH TABLE MOUNTAIN, LEUCITE HILLS, WYOMING

This flat-topped mesa is capped by 50 to 100 feet of 8 to 11 per cent potash-bearing rock. The Leucite area covers at least 10 square miles, and thus contains billions of tons of potash. Our granite hills also contain large percentages of potash, all at present unavailable, as no cheap method of extracting the potash has yet been developed.

covering an immense area, are also rich in potash. In Utah and in the Goldfield district of Nevada important occurrences of alunite are reported, containing a possible important commercial source of potash.

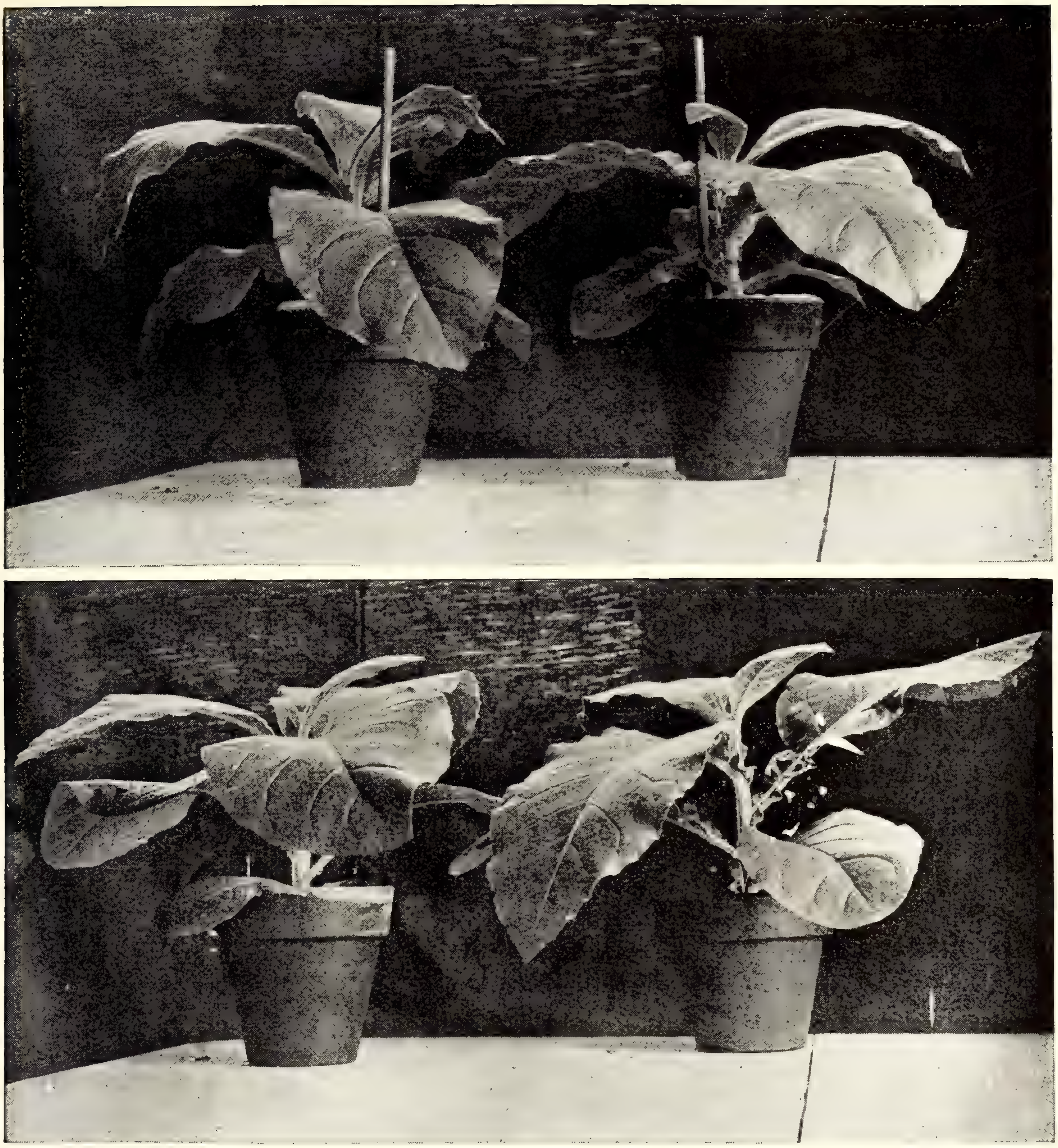
The supply of potash is, therefore, limitless. The trouble has been that inasmuch as the potash in these rocks is not soluble, as are the potash salts, it is not readily available as plant food. But it is not conceivable that it will long remain an unsolved problem to the chemist to extract potash from rocks on a commercial basis. Indeed it has been done in the laboratory again and again, and very recently several patents have been granted for processes devised for large-scale operations. One method only may be mentioned as showing that success is practically assured in unlocking the potash treasure vault and thus challenging German supremacy. Dr. Allerton S. Cushman, late of the Department of Agriculture, has perfected a process for treating ground feldspar with lime and other reacting substances and furnacing the mixture. He has already succeeded in thus rendering soluble 60 per cent of the potash contained in the feldspar, and expects to release the entire potash content when the process is put into commercial operation, using large rotary kilns, such as are employed in Portland cement manufacture. Working with 10 per cent potash feldspar, he will thus obtain a marketable product from three to four times as rich in potash as the ordinary "complete fertilizer" used by the farmer.

Methods of releasing the potash by electrical methods and others for recovering it as a by-product in the manufacture of cement and in various other ways are being worked out. In the grinding and converting of rock into cement, immense quantities of the potash of our hillsides are now wasted which might perhaps be saved. If science has already solved the intricate problem of converting the free nitrogen in the atmosphere into nitrate salts for fertilizer, the counterpart of Chilean nitrate of soda, it is not to be doubted that under the spur of necessity American chemists will get the potash out of rocks which are to be found at every hand. Moreover, there are vast fortunes in it for the men who develop practicable processes.

Doctor Cushman carried on, under the Department of Agriculture, a series of experiments, which indicate that the simple process of pulverizing feldspar makes it largely available as a plant food. He matured tobacco plants, which require large quantities of potash, using the ground feldspar as the sole potash fertilizer. If there were no better potash supply possible, ground feldspar or granite would undoubtedly be in general use as a fertilizer. It is probable that further experiments along these lines under various conditions will show a still greater and possible practical value for ground raw feldspar as a fertilizer.

Lime and water will have a dissolving effect on the potash in the fine particles of the rock, and it may be shown that if instead of spreading lime alone, as is common farm practice, considerable ground feldspar is added, the potash may be released year by year, just about as the plant needs it. In a similar way ground rock phosphate is now used to a considerable extent, although for years the statement was accepted that the phosphorus in rock phosphate was absolutely unavailable as a plant food unless the rock was treated with sulphuric acid. But it has been shown by several of the agricultural experiment stations that when applied to certain kinds of soils, heavy in humus, or when used in connection with barnyard manure, raw ground phosphate has a very great fertilizing value. With more extensive experiments similar good results may be expected in the use of potash-rich rocks.

In the agricultural appropriation law Congress also appropriated $12,500 to enable the Bureau of Soils to carry on potash investigations, and with the work vigorously pushed some definite results will in all probability be attained. This Bureau has a magnificent opportunity to determine and perfect a practicable method of extracting potash from rocks,



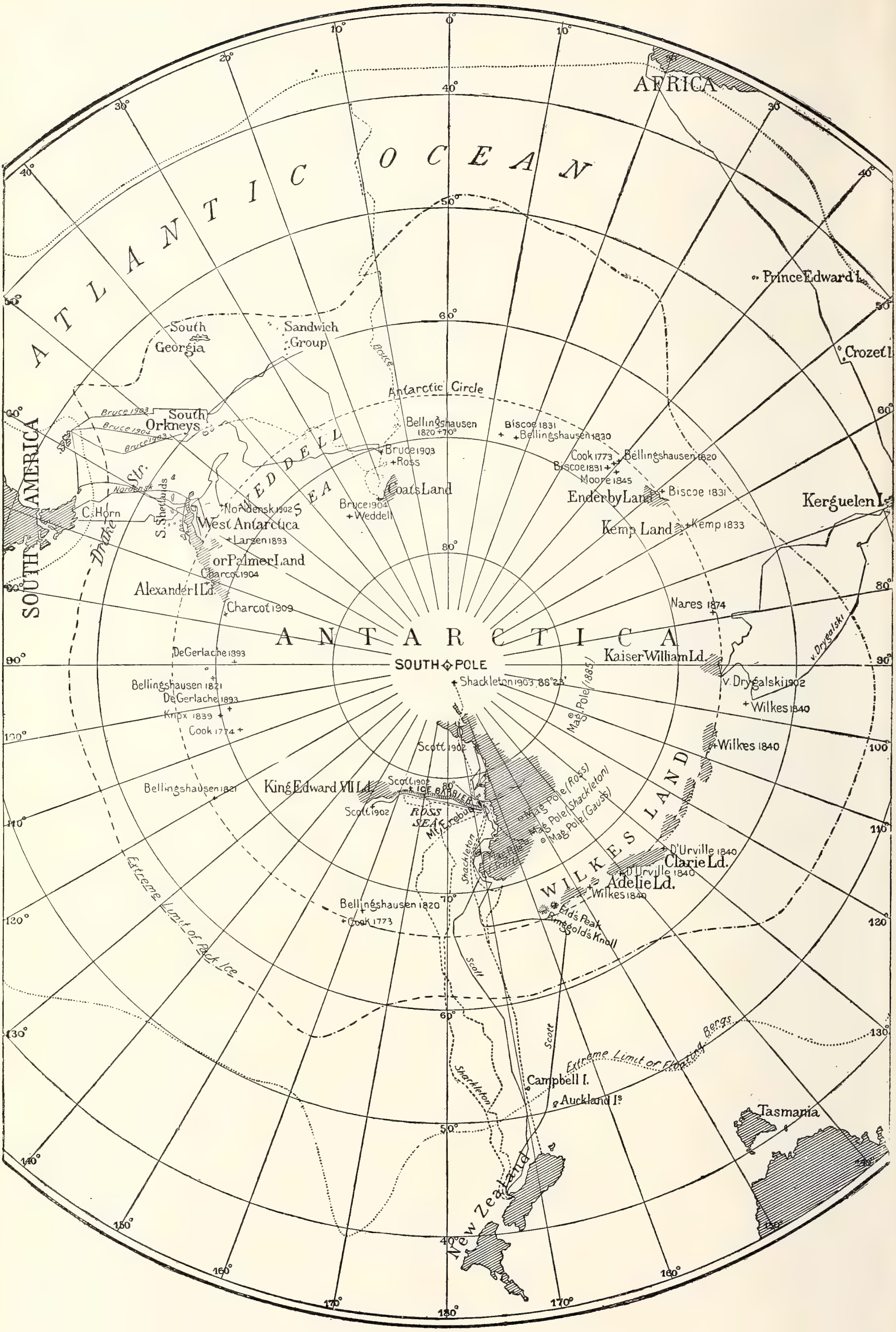
Photos by Allerton S. Cushman

THE EFFECTIVENESS OF GROUND FELDSPAR AS A POTASH FERTILIZER

Comparison of tobacco seedlings, six weeks old, grown in sand mixed with ground feldspar, but containing no other potash (shown in upper photograph), with plants of same age grown in rich garden soil, which contains an adequate supply of soluble potash (shown in lower photograph). Dr. Cushman emphasizes the fact that this experiment was under most favorable green-house conditions and is not to be taken as applicable to field practice. The showing is, however, significant.

and thus forestall the possibility of an American potash monopoly.

While the outlook for the early development of an American potash supply, and consequent relief for the farmers, is, on the whole, most promising, it is to be regretted that Congress did not provide for more extensive work by the Government. A $200,000 appropriation would have enabled the Geological Survey, for instance, to distribute ten or a dozen parties with deep-drilling outfits over the western country and to find the nitrate and the potash beds at once, rather than to spread the effort over a period of years, and finally make the discovery after we have sent a quarter or a half a billion dollars to Germany and Chile. Nor would $50,000 have been too much to give the Secretary of Agriculture for exhaustive chemical investigations in potash and to continue and expand the promising experiments already begun by his department.



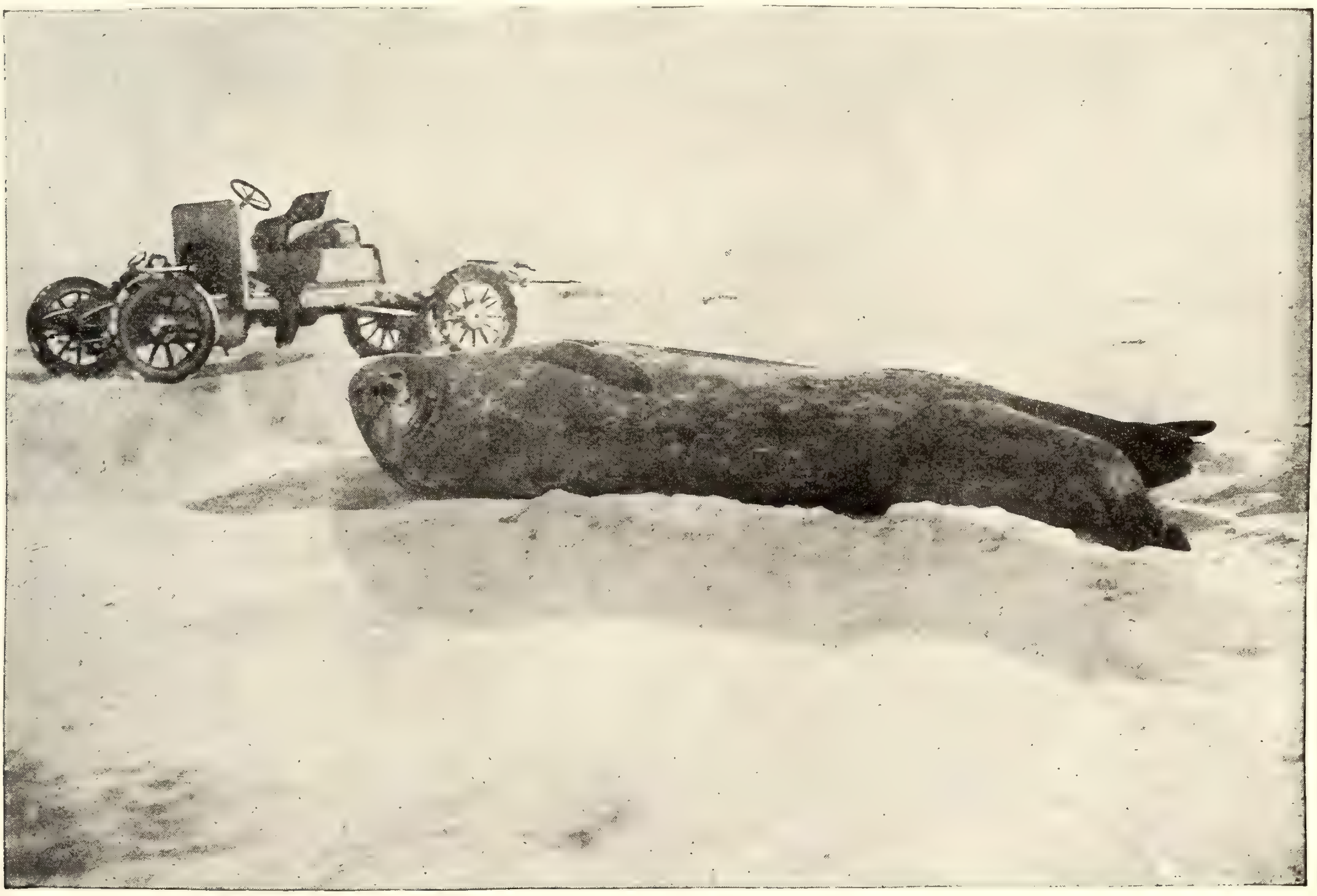
SKETCH MAP OF THE SOUTH POLAR REGIONS

SOUTH POLAR EXPLORATIONS

THREE expeditions, a British, a Japanese, and a Norwegian, will be struggling during the next 12 months to reach the South Pole. Unfortunately for scientific purposes, all three are endeavoring to gain the goal by practically the same route—from the vicinity of Mount Erebus over the great ice barrier, and then up over the great inland plateau. This is the route discovered by Scott and Shackleton, and over which the latter gained a point within 97 miles of the Pole in 1909 (see map on opposite page).

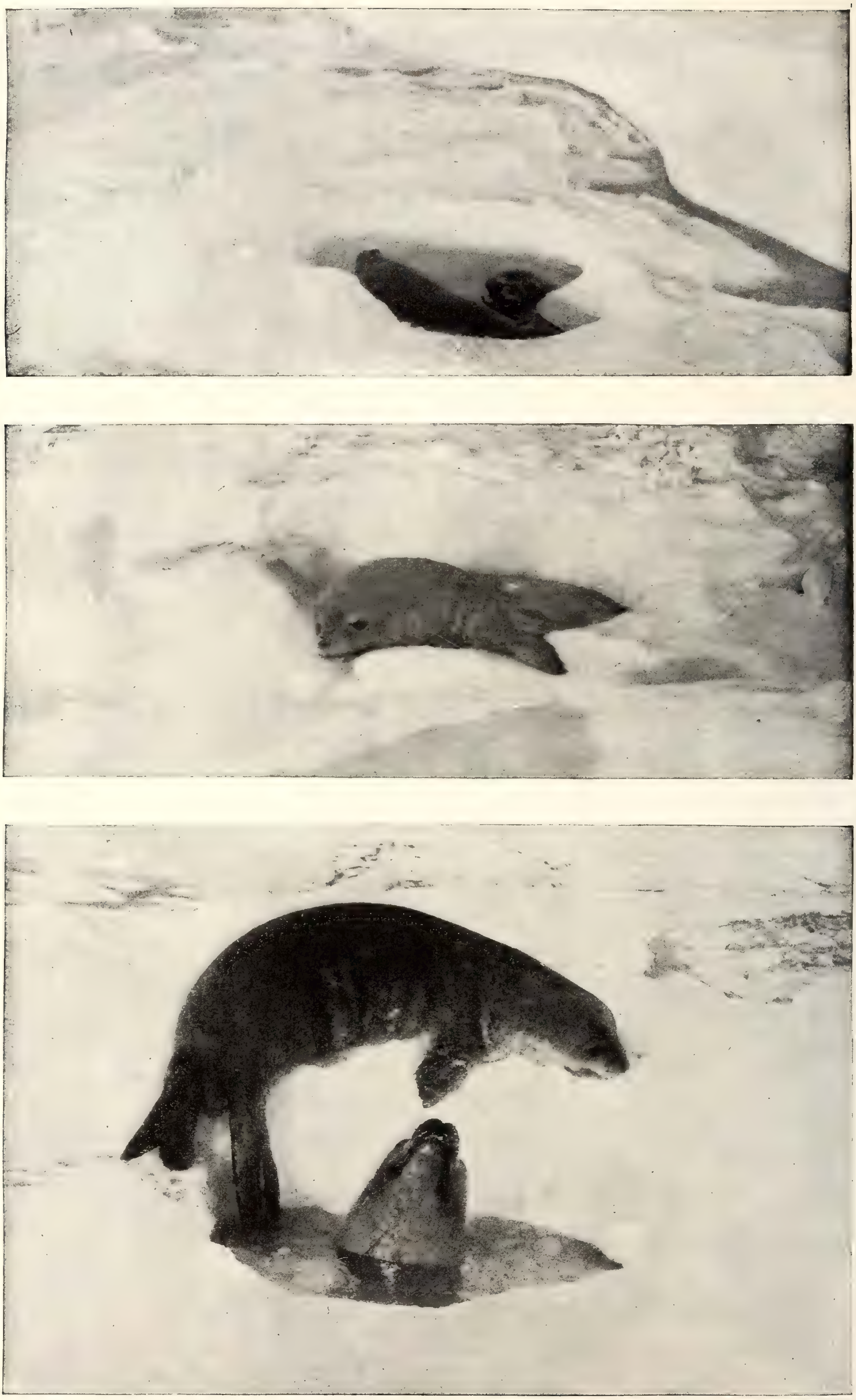
The British expedition is led by Capt. Robert F. Scott, of the Royal Navy, who directed the very successful British party of 1901-'04. Two years were spent in preparations for this last expedition, which left England in June, 1910. The party comprises 60 persons, including a large number of scientists and scientific assistants. They are provisioned for three years, and are using as their headquarters the same base that was occupied by Scott, 1901-'04, and by Shackleton, 1908-'09.

The *Terra Nova,* which has recently returned after landing Scott's sledge parties, reports that Amundsen, the leader of the Norwegian party, is also camped near by. Amundsen, it will be remembered, had been planning for several years to reach the North Pole by drifting across it. When he left Europe on the *Fram* in 1910, it was with the announced intention of proceeding around Cape Horn, thence up the Pacific through Bering Strait into the Arctic Ocean, where he was to allow his ship to be frozen in the ice. He was provisioned for five years, at the end of which time he expected to have drifted across the North Polar area and to be freed in the vicinity of Iceland or Norway. But from Madeira Amundsen cabled that he had altered his plans and would spend a year endeavoring to reach



SEAL SUCKLING YOUNG AND TAKING NO NOTICE OF THE MOTOR CAR

Photo taken on the Great Ice Barrier. From E. H. Shackleton, "The Heart of the Antarctic." J. B. Lippincott Co.



SEALS EMERGING FROM THE WATER AT THEIR BLOW-HOLES, NEAR MOUNT EREBUS

Photos from "The Heart of the Antarctic," by E. H. Shackleton. J. B. Lippincott Co.

the South Pole. It is presumed that he sought to land his party on King Edward VII Land, some distance from Scott's intended headquarters, but, like all explorers who have preceded him in this region, failed to find a satisfactory point for disembarking, and was compelled to continue along the great ice barrier to Mount Erebus.

The cabled advices have stated that Amundsen was to inaugurate his attack upon the Pole immediately, not waiting for the winter to pass before beginning his advance. From this we infer that he intends to take advantage of moonlight and advance depots of supplies up the route during the brighter periods of the polar night. Previous South Polar expeditions have confined their explorations almost entirely to daylight, though Peary's success in gaining high latitudes in the Arctics was largely due to the fact that he kept his sledging parties at work during the full moon.

The Japanese party is led by Lieutenant Shirase. Like Amundsen's, it is small in numbers. Shirase has not had the training in ice-work that Scott and Amundsen have experienced, and it is doubtful whether the heroic spirit of his party can prevail against the lack of equipment.

OUR DESERT PANORAMA

FOR the convenience of such readers of this Magazine as desire to frame the beautiful panorama, "The Hour of Prayer: In the Sahara Desert," which is published as a supplement to this number, a limited number of copies have been printed on very heavy art mat paper suitable for framing. The copies are unfolded, and may be obtained by applying to the office of the National Geographic Society and enclosing 50 cents for each copy desired.

The panorama is probably the most extraordinary desert scene that has ever been published. It represents a portion of the Sahara Desert not far from Biskra, and is typical of the vast billows of sand which cover many sections of the great desert.

As we look at the oceanic ridges in the picture we can easily understand the terrors of the desert storm, which has been described by many travelers.

We quote from Mary Somerville:

"The wind at the equinoxes rushes in a hurricane, driving the sand in clouds before it, producing the darkness of night at midday and overwhelming caravans of men and animals in common destruction. Then the sand is heaped up in waves ever varying with the blast; even the atmosphere is sand. The desolation of this dreary waste, boundless to the eye as the ocean, is terrific and sublime."

Duveyrier, in "Les Touareg du Nord," writes:

"The sand storms I have seen always took the form of vast clouds of a red color, appearing as if shot with fire, having a thickness of 50 to 60 meters and moving as rapidly as high winds, sometimes just above the surface of the ground, sometimes considerably higher, now dropping to the ground, now rising, but in any event moving through the atmosphere like a foreign and entirely isolated body.

"On one journey through the desert I had a near view of four such storms, and a fifth enveloped our entire caravan without our being able to escape it. . . .

"The storm on April 28 passed to the east of us like an immense reddish cloud and appeared like a vast conflagration. The likeness was so close that it might have deceived us if the cloud had not moved in such a way as to vary its height with respect to the horizon.

"It need hardly be said that while the sirocco lasts traveling is very painful, especially in the region of the dunes. Stories are told of entire caravans being engulfed by avalanches of sand. While traversing the Erg during the hottest season of the year, when the wind was blowing constantly from the south, our caravan, worn out by the whirlwinds of sand which darkened the atmosphere and prevented the guides from leading the way, had to stop several times."

The most terrible form of the desert storm is the simoon, "the poison wind." As it approaches the observer its front extends at least from 5 to 20 miles, very much like the advancing front of a series of thunder-storms on a hot afternoon; the clouds of fine sand and dust that are carried up by the wind extend as a haze overspreading the sky; the heavier sands are also transported in large quantities, and as they fall are collected in mounds around every obstacle like the drifts of snow in winter. In the case of an extended simoon the finer sands are carried so high as to be drawn into the general circulation over Europe. Thus in the great storm of March 10-12, 1901, red and yellow sand and dust from the Sahara fell in nearly every portion of Germany, France, Austria, and Turkey, and southward over the Mediterranean, and was also reported in southern England for the first time on record.

In his explorations amid the sand dunes of Asia, Sven Hedin encountered many furious sand storms.*

"For it drove right into my face with terrific violence, smothering me with sand and fine reddish yellow powdery dust. I could not see a single glimpse of the caravan. It was like wading against running water or liquid mud, and despite my most desperate efforts I was unable to make headway. My previous footprints were entirely obliterated—obscured the instant I lifted my foot. . . .

"The camels knelt in a long row, with their necks stretched out flat on the ground in the direction in which the tempest was blowing. Close to the earth the wind had a velocity of 40½ miles an hour; but on the top of an adjacent mound, only 6 or 7 feet high, it was some 18 miles an hour more, or 58½ miles in all, and I was only able to keep my balance when I knelt. The storm came from the northeast, and its violence enabled me to form some idea of the inconceivable quantities of sand and dust which are transported by this mighty agent. When we stooped down we were well nigh choked by the swirling cloud, which careered along the ground like a cataract, making little eddies of dust as it swept on. Branches, tufts of grass, grains of sand as big as peas were whirled into our faces with stinging force. . . .

"Only those who have been out in such a storm can form any conception of what it is like. You get bewildered and want to keep going, without knowing where. Your sense of locality is paralyzed, and although you think you are going in a straight line, you are in reality describing a circle. It is a kind of desert storm sickness, more nearly resembling the panic which seizes a person on the edge of a precipice than seasickness or mountain-sickness, because it affects the brain."

MAP OF MEXICO.

A LARGE map of Mexico, 18 by 25 inches, and in colors, will be published as a supplement to the next number of the NATIONAL GEOGRAPHIC MAGAZINE. The map gives the railway lines, names of towns and villages, and all the latest geographical information. The elevations of the different parts of Mexico are shown by gradations of color.

The same number will contain two notable articles on Mexico, "Our Neighbor, Mexico," by Mr. John Birkinbine, President of Franklin Institute, Philadelphia, and formerly President of the American Institute of Mining Engineers; and "Lower California," by Mr. E. W. Nelson, of the United States Biological Survey.

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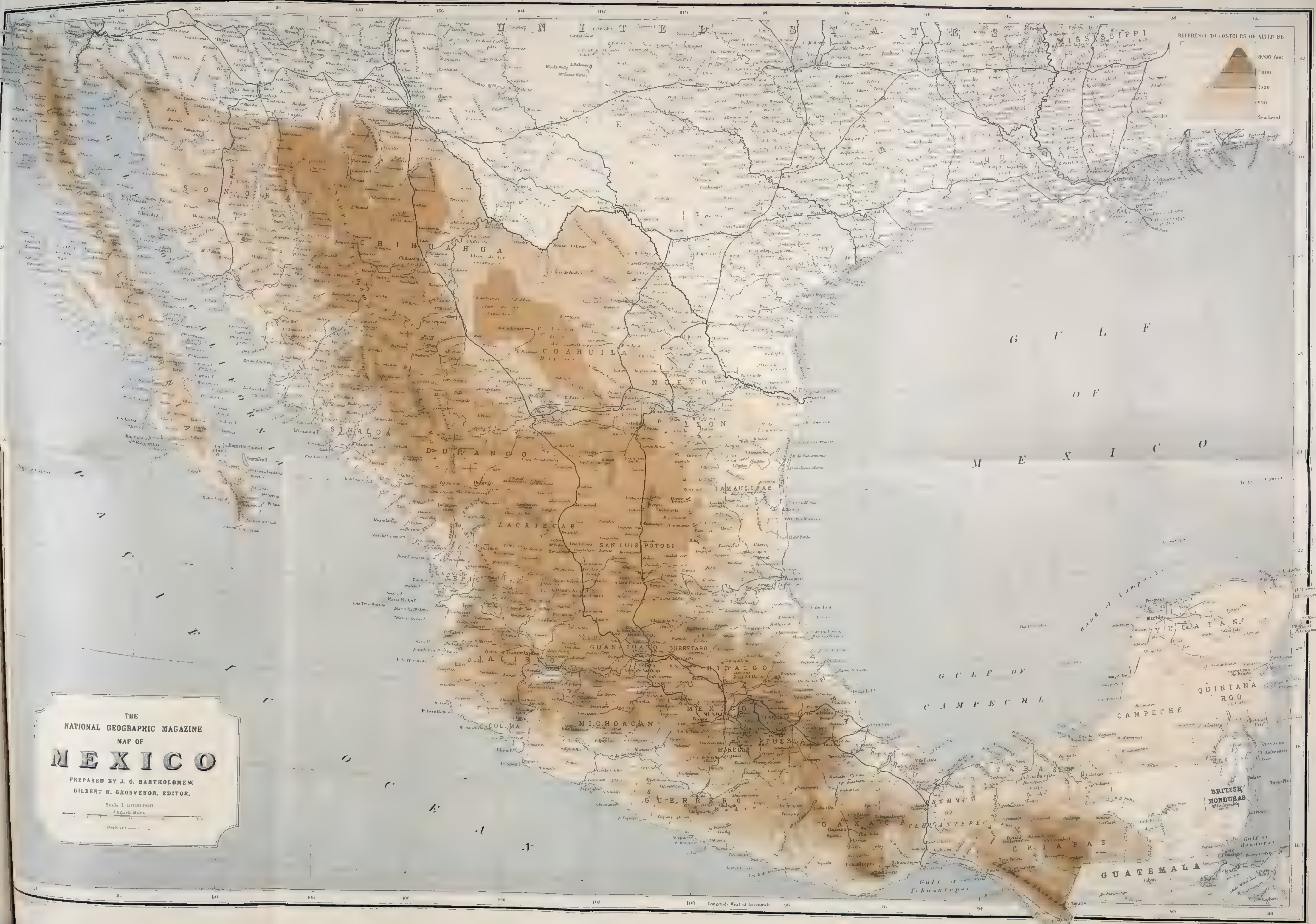
* From "Central Asia and Tibet," Sven Hedin. Charles Scribner's Sons.


THE
NATIONAL GEOGRAPHIC MAGAZINE
MAP OF
MEXICO
PREPARED BY J. G. BARTHOLOMEW,
GILBERT H. GROSVENOR, EDITOR.
Scale 1:5,000,000
English Miles
REFERENCE TO CONTOURS OF ALTITUDE
8000 feet
5000
2000
500
Sea Level
UNITED STATES
TEXAS
LOUISIANA
MISSISSIPPI
SONORA
CHIHUAHUA
COAHUILA
NUEVO LEON
TAMAULIPAS
SINALOA
DURANGO
ZACATECAS
SAN LUIS POTOSI
AGUASCALIENTES
TEPIC
JALISCO
GUANAJUATO
QUERETARO
HIDALGO
COLIMA
MICHOACAN
MEXICO
TLAXCALA
PUEBLA
MORELOS
GUERRERO
OAXACA
VERA CRUZ
TABASCO
CHIAPAS
CAMPECHE
YUCATAN
QUINTANA ROO
BRITISH HONDURAS
GUATEMALA
LOWER CALIFORNIA
GULF OF CALIFORNIA
PACIFIC OCEAN
GULF OF MEXICO
GULF OF CAMPECHE
ISTHMUS OF TEHUANTEPEC
Gulf of Tehuantepec
Gulf of Honduras
Longitude West of Greenwich

VOL. XXII, NO. 5 WASHINGTON MAY, 1911

THE NATIONAL GEOGRAPHIC MAGAZINE

SHORE-WHALING: A WORLD INDUSTRY

BY ROY CHAPMAN ANDREWS

ASSISTANT CURATOR OF MAMMALS, AMERICAN MUSEUM OF NATURAL HISTORY

With Photographs by the Author

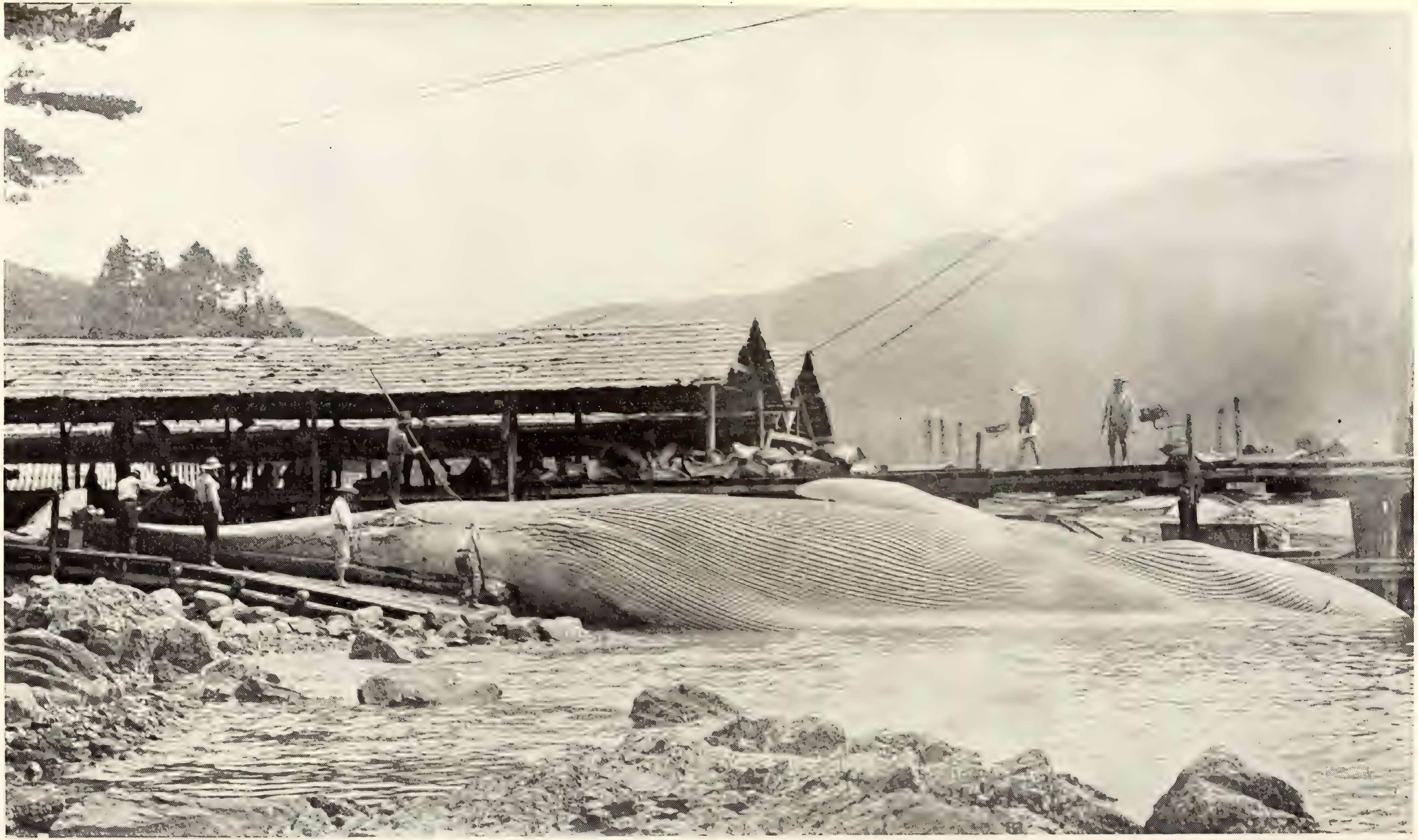
IF THE European and American people could be educated to the point of eating the canned flesh of animals which individually yield as much as 80,000 pounds of meat, what a wonderful food supply would be within reach of the poor in our great cities! In Japan this has actually been accomplished and hundreds of tons of whale flesh are sold in the markets of all the large towns and villages to people who would otherwise have little variety to their diet of rice and fish.

This great meat supply has been put into their hands indirectly by a Norwegian, for it was not until 1864, when Swend Foyn invented the harpoon-gun, that whales could be taken in such a manner as to allow any parts except the oil and baleen (the "whalebone" of commerce) to be utilized.

With the further development of the harpoon-gun grew up a new and great industry, for it made possible the capture of a group of whales known as rorquals, or "finners," in sufficient numbers to warrant the erection of stations at certain points on the shore where the animals could be brought in and the huge carcasses converted into commercial products. Previously these whales had been little troubled by the men who hunted in a small boat with a hand harpoon and lance, for the great speed of the animals and their tendency to sink as soon as killed, as well as their thin blubber and short, coarse baleen, made them unpopular with the early whalers.

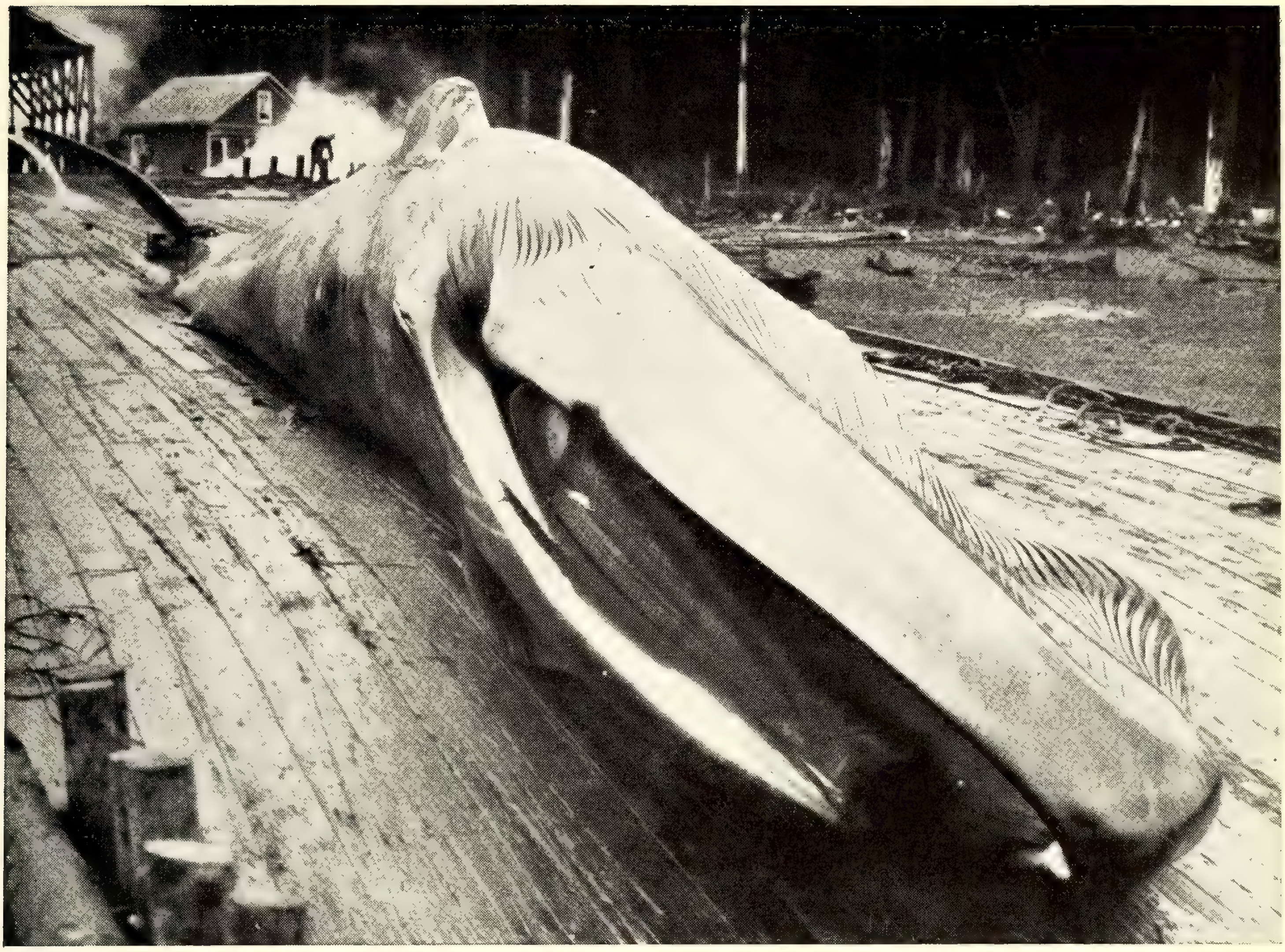
In a few years stations had sprung up on the coasts of Norway in every available place, and later reached across the Atlantic to the American shores. Newfoundland became the first hunting grounds for the whalers here, and only a few years ago as many as 18 stations were in operation on that island and the immediate vicinity.

The great success of the Norwegian methods attracted so much attention that stations were erected in every part of the world where conditions were favorable—in British Columbia, southeastern Alaska, Bermuda, South America, and the islands of the Antarctic; on the coasts of Japan, Korea, Africa, and Russia. Australia is soon to be invaded, and only a few months ago a company announced their plans for carrying on operations on a large scale in the Aleutian Islands. In New Zealand, hump-



A BIG BLUE OR SULPHUR-BOTTOM WHALE: JAPAN

"The blue or sulphur-bottom whale found in all our oceans is not only the largest animal that lives today, but is also, so far as is now known, the largest animal that has ever existed on the earth or in its waters. I have heard many stories of the almost incredible way in which these animals can pull, but was at first inclined to doubt them. Later, when I saw a blue whale with a harpoon between the shoulders drag the ship, with engines at full speed astern, through the water almost as though it had been a rowboat, I began to listen with more respect" (see page 427).



A BLUE WHALE: VANCOUVER

Although the mouth is enormous, large enough in fact to permit 10 or 12 men to stand upright in it, the throat measures only about 9 inches in diameter (see page 427)

back whales are being taken in wire nets, and so in nearly every part of the globe the world-hunt goes on.

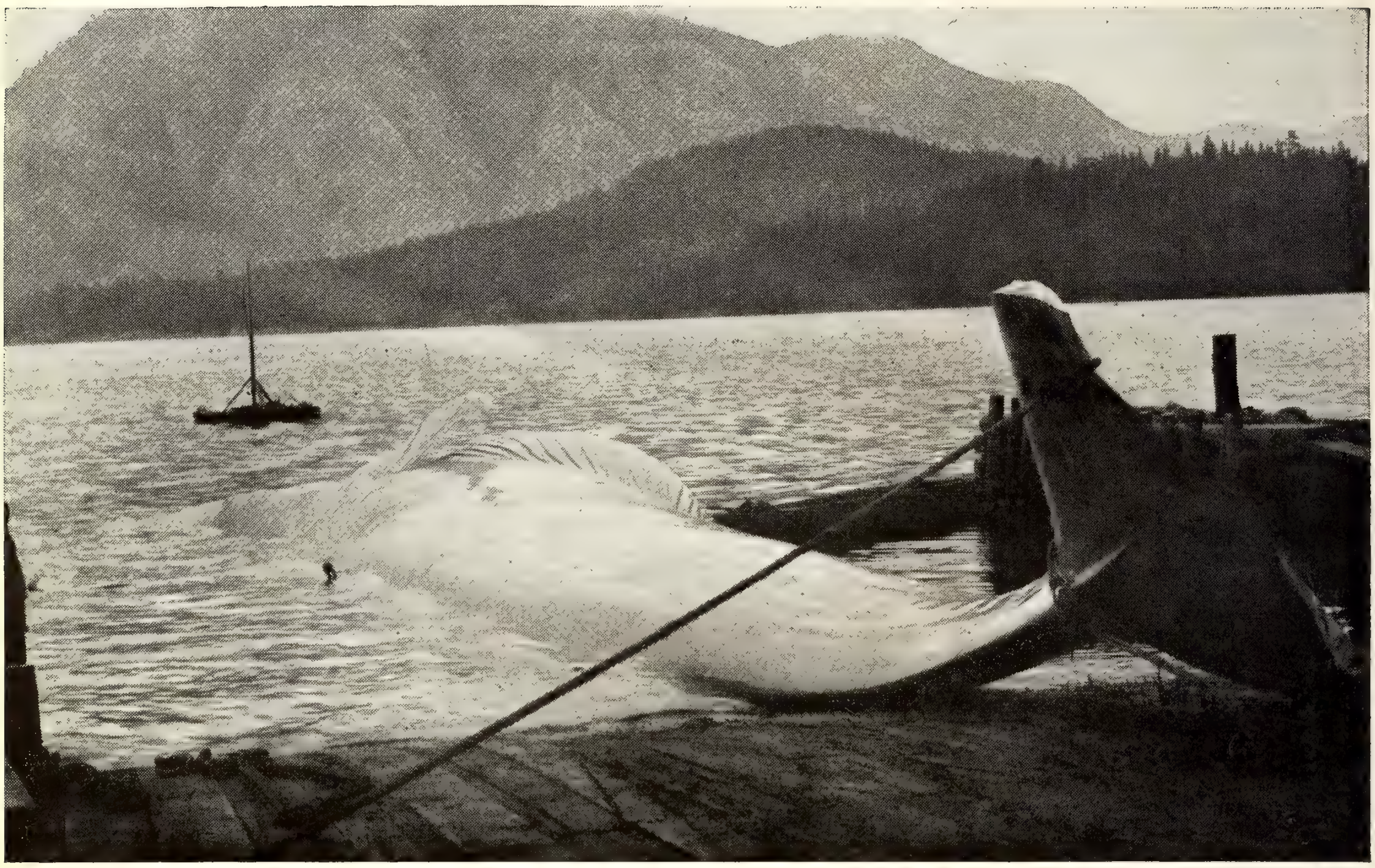
And what is to be the result of this wholesale slaughter? Inevitably the commercial extinction of the large whales, and that within a very few decades. In some localities this has already taken place and all the whales have been killed or driven from their feeding grounds.

This method of capture has, however, made possible a careful study by naturalists of most of the species of large whales and their habits, besides enabling museums to secure skeletons and other specimens for exhibition. Thus, when the American Museum of Natural History in New York city began to gather such material, it led to a series of expeditions which carried the writer to a number of stations in widely separated parts of the world.

THE ENORMOUS BODIES EASILY HANDLED

I will never forget my intense surprise at the extraordinary ease and quickness with which the enormous carcasses are handled when I first saw a whale "cut in." It was at Sechart, in Barclay Sound, on the west coast of Vancouver Island. Here, as at all of the American stations, the operations are carried on in the Norwegian way.

The ship had arrived at 1.30 a. m. with three humpbacks, which were left floating in the water, tied to the end of the wharf, near a long inclined platform called the "slip." Work began at seven o'clock, and, as I had only just been awakened, I ran out without waiting for breakfast, thinking that there would be ample time to eat when the operations were under way. I soon learned, however, that there were no "breathing



A BLUE WHALE: VANCOUVER

Specimens of this whale have been measured which reached a length of 87 feet, and, in all probability, weighed as much as 75 tons (see page 427)

spells" when whales were being cut in, and every soul was at his work until the whistle blew for dinner at noon.

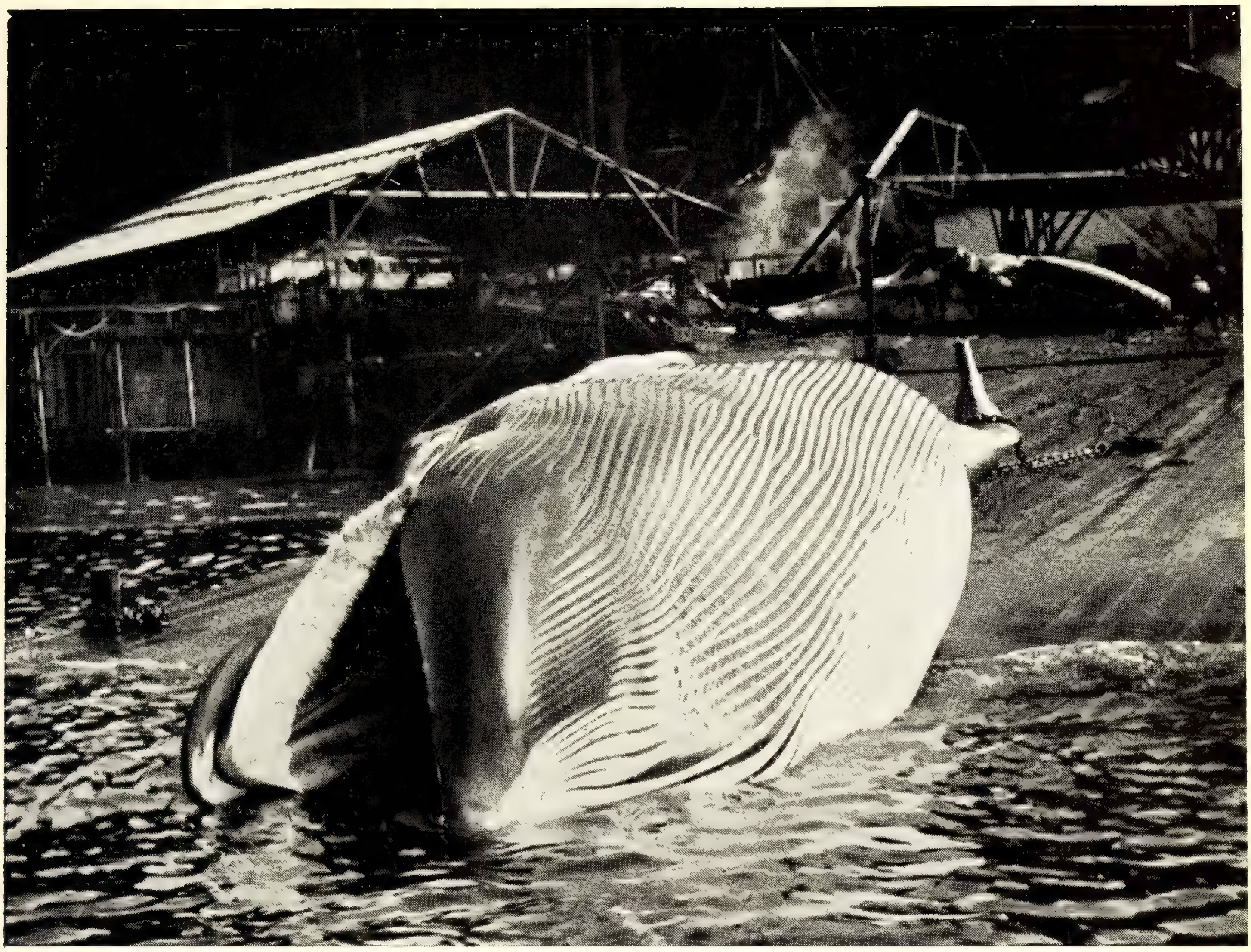
A heavy wire cable was made fast about the posterior part of one of the whales just in front of the tail, or "flukes," and the winch started. The cable straightened out, tightened, and became as rigid as a bar of steel. Slowly foot after foot of the wire was wound in and the enormous carcass, weighing perhaps 45 tons, was drawn out of the water upon the slip.

One of the Japanese (for men of six nationalities—Chinese, Japanese, Norwegians, Newfoundlanders, Indians, and Americans—are employed at these west-coast stations) scrambled up the whale's side, and balancing himself on the smooth surface by the aid of his long knife, made his way forward to sever at the "elbow" the great side fin, or flipper, 16 feet in length.

THE WHALES ARE PEELED LIKE AN ORANGE

Before the carcass was half out of the water other cutters, or "flensers," as they are called, had begun to make longitudinal incisions through the blubber along the breast, side, and back, and from the flukes the entire length of the body to the head. The cable was then made fast to the blubber at the chin, the winch started, and the great layer of fat stripped off exactly as one would peel an orange. When the upper side had been denuded of its blubber covering, the whale was turned over by means of the "canting winch" and the other surface flensed in the same manner.

The blubber is a layer of fat of varying thickness which covers the entire body of all whales, porpoises, and dolphins and keeps the animal warm. It acts exactly as the feathers of birds or the hair of land mammals—as a non-conductor to prevent the natural heat of



A FINBACK WHALE: VANCOUVER (SEE PAGES 428 AND 437)

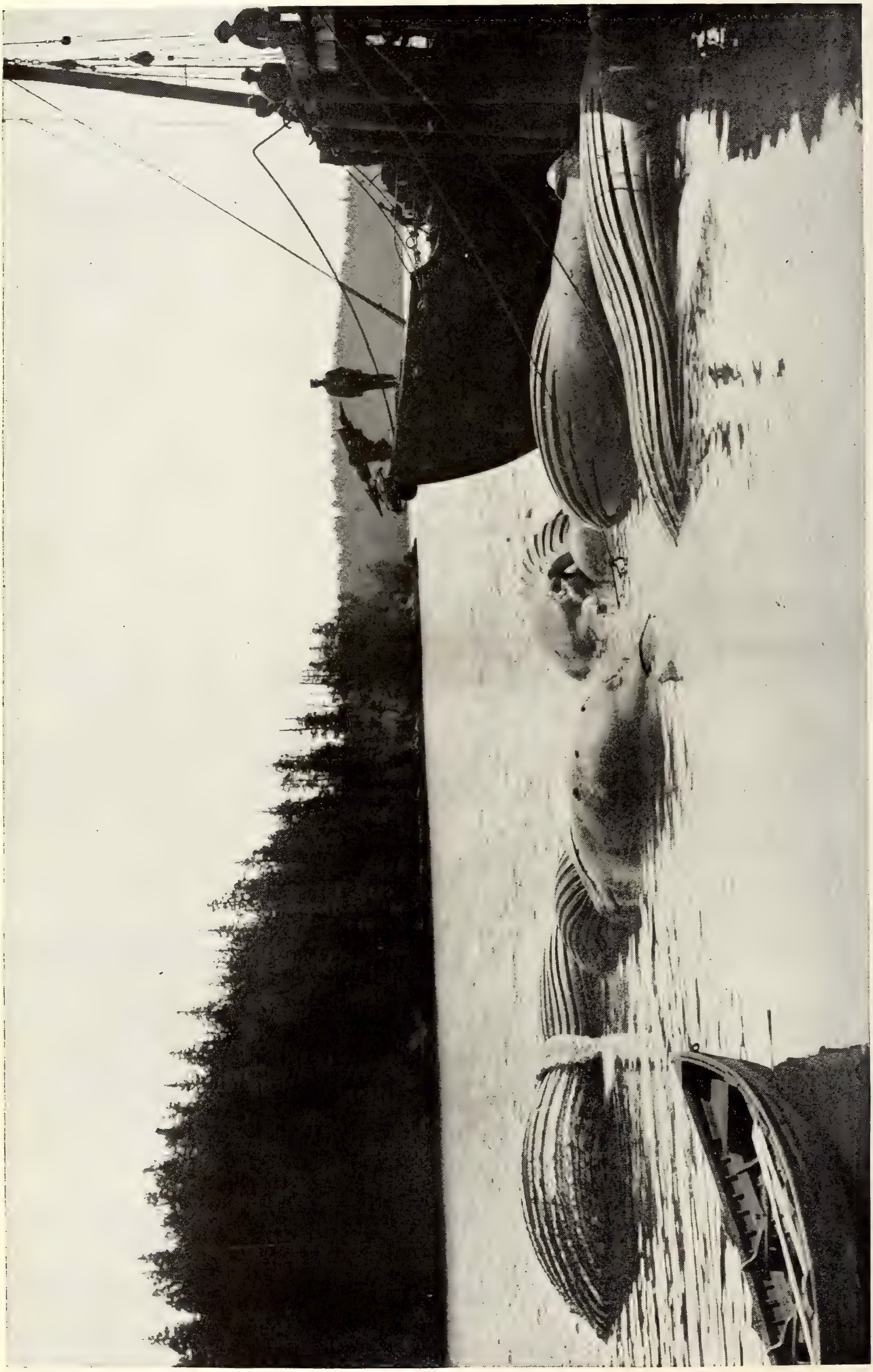
the body from being absorbed by the water in the one case, and the air in the other. On the great bowhead, or Greenland right whale, which lives in the intensely cold waters of the Arctic Ocean, the blubber is 12 or 14 inches thick in some places (see pages 427, 435, 438).

When the "blanket pieces," as the blubber strips are called, were torn from the carcass, they were cut into large oblong blocks and fed into a slicing machine, chipped to small bits, carried upward and dumped into enormous vats, to be boiled or "tried out" for oil.

The carcass had meanwhile been split open by chopping through the ribs of the upper side, a heavy hook was attached to the tongue bones at the throat, and the entire mass of heart, lungs, liver, and intestines drawn out at once. The body was then hauled to the "carcass platform," at right angles to the "flensing slip," the flesh torn from the bones by the aid of the winch, and the skeleton disarticulated.

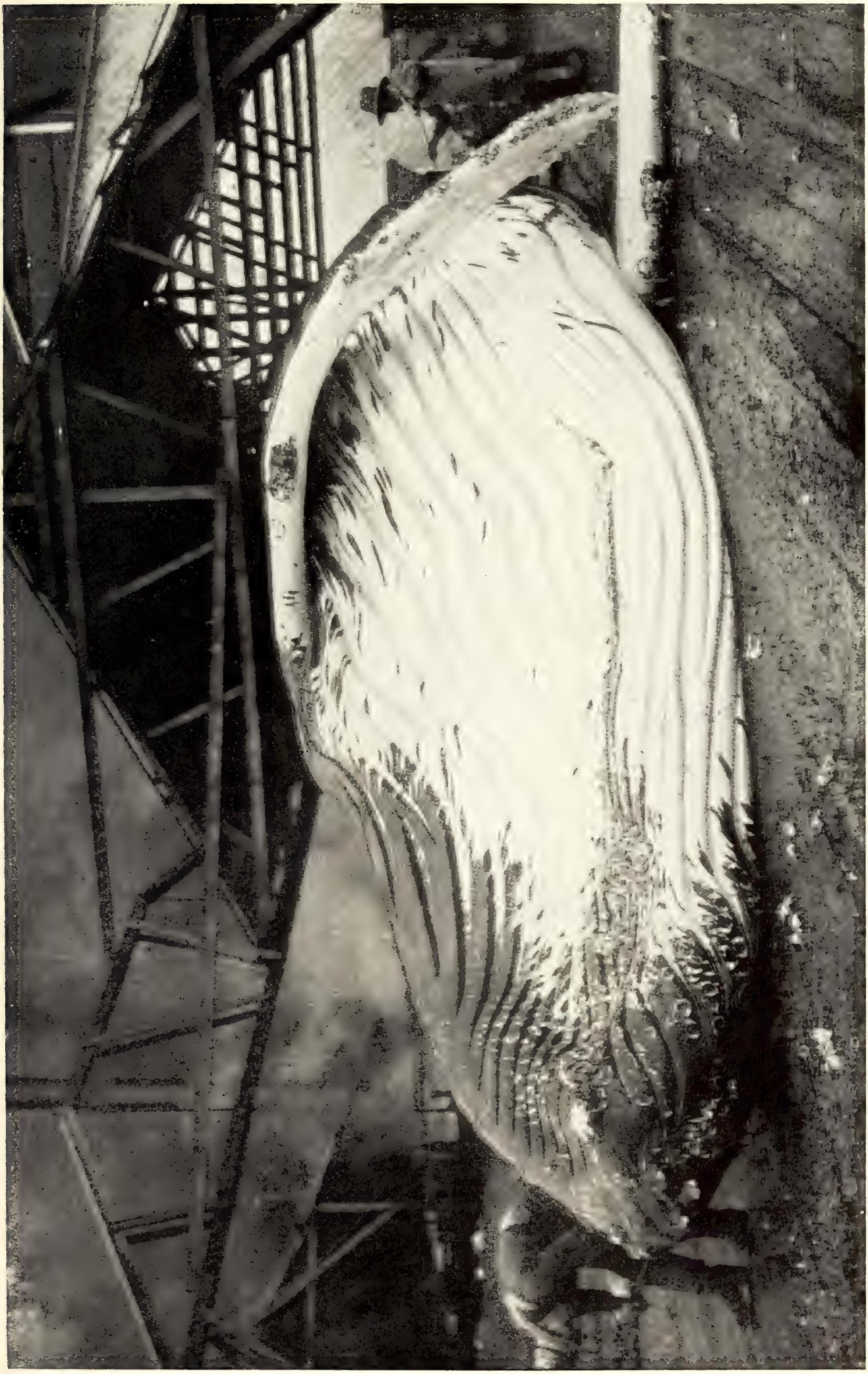
Both flesh and bones were piled separately into great open vats which bordered the carcass platform, and boiled to extract the oil. The flesh was then artificially dried and sifted, thus being converted into a very fine guano, and the bones pulverized to form "bone meal," also a fertilizer. Even the blood, of which there are several tons in a large whale, was carefully drained from the slip into troughs, boiled, dried, and made into guano. Finally, the water in which the blubber had been tried out was converted into glue.

The baleen, or whalebone, which alone remained to be disposed of, was thrown aside, to be cleaned and dried as opportunity offered. The baleen of all the rorquals is short, coarse, and stiff, and



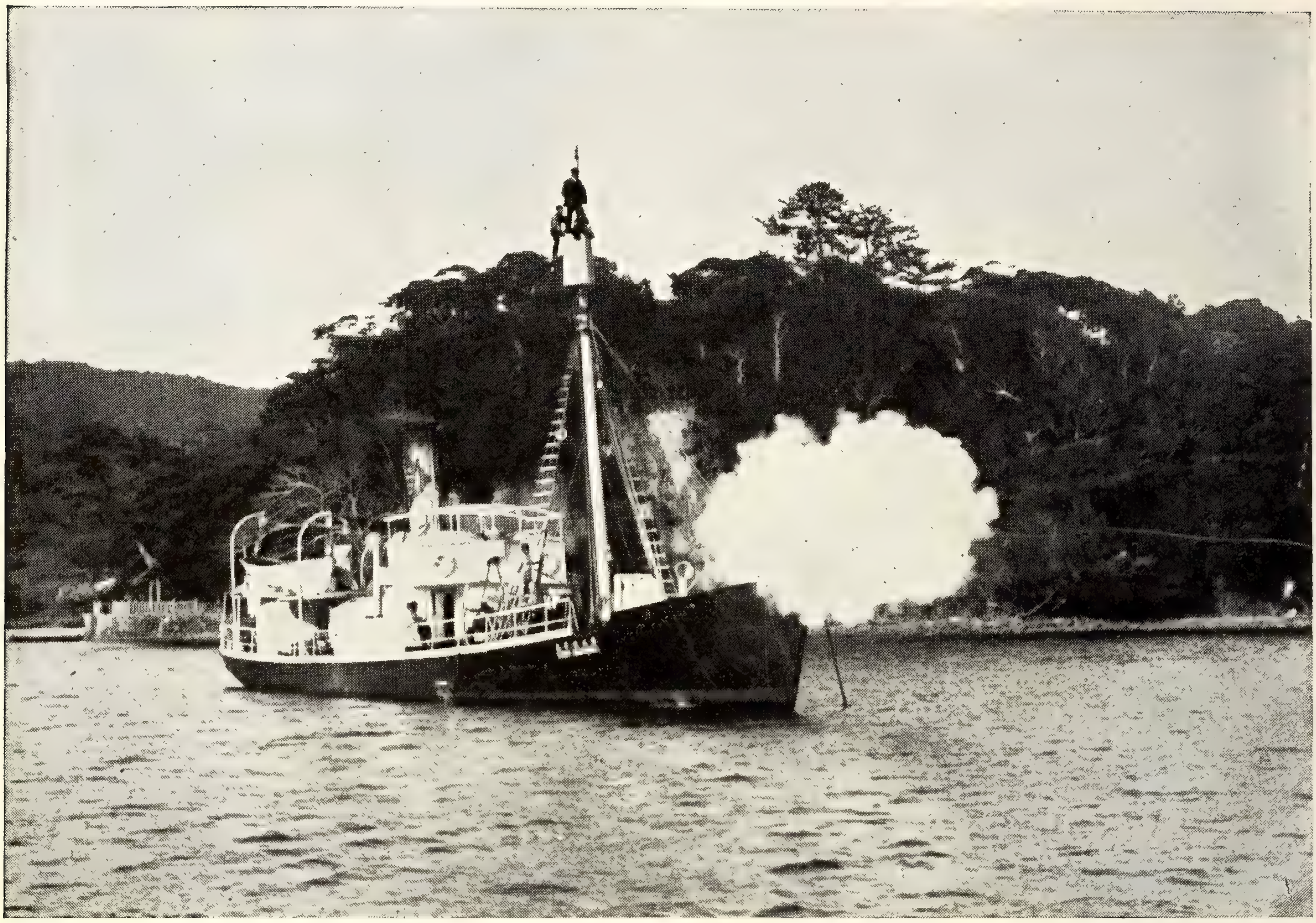
THE CARCASSES OF FIVE HUMPBACK WHALES: VANCOUVER

This whale is considerably smaller than the blue whale, its maximum size being 55 feet (see pp. 428–430). Photo by courtesy of World's Work



A VERY WHITE HUMPBACK WHALE, VANCOUVER: NOTE THE CRAB-LIKE FLIPPER

"Its body is thick and heavy, with enormous side fins, or flippers. These great paddles are one-quarter the length of the entire body, and a single one from a whale 49 feet long weighed on the station scales 956 pounds" (see pages 428-430)



A MODERN WHALER IN PORT

The crew are practicing by shooting at a floating target

in Europe and America has but little value. In Japan, however, it is made into many useful and beautiful things.

This, with the exception of minor details, is the method of handling whales which the Norwegians developed after years of experimenting, and which is followed in almost all other parts of the globe except Japan.

THE JAPANESE WHALE FISHERIES

In the Island Empire shore-whaling as a great industry has developed during the last 15 years, but nowhere else in the world are the by-products so perfectly utilized. The Japanese have not only extracted the best from the European methods of preparing whales and adapted it to their peculiar needs, but have also added much from their own experience which whalemen of other nations would do well to recognize.

The Japanese stations are usually situated in or near one of the little fishing villages which dot the islands in every bay or harbor. In some instances the whales are drawn out of the water upon a slip in the manner learned from the Norwegians, but the more usual way of cutting in is a method of their own adoption.

At the end of a wharf extending into deep water a pair of long, heavy poles are erected, inclined forward, and joined at their extremities by a massive crosspiece. From this the great blocks, through which run the wire cables of the winch, are suspended.

The first whale which I saw cut in by the Japanese was an enormous sulphur-bottom, 80 feet in length. I had been at sea for several days on one of the ships, and as we swung into the bay from the open ocean, the whistle echoing among the hills gave warning of our coming. The little vessel, towing a carcass almost as long as herself, plowed slowly up to the wharf, and after a rope from the shore had been made fast to the flukes of the whale, dropped it into the water and backed off to anchor in the bay.

Immediately a heavy chain was made fast about the body just forward of the tail, the winch started, and the whale drawn slowly into the air over the end of the wharf. As it came upward the eager cutters attacked it, slicing off enormous blocks of flesh and blubber, which were at once seized by "hookmen" and drawn to the back of the platform. Meanwhile two other cutters were at work in a "sampan" dividing the carcass just forward of the dorsal fin. The entire posterior part of the whale was then drawn upward and lowered on the wharf to be stripped of blubber and flesh. Transverse incisions were made in the portion of the body remaining in the water, a hook fastened to a blanket piece, and as the blubber was torn off by the winch the carcass rolled over and over. The disjointed head was hoisted bodily onto the pier. Section by section the carcass was cut apart and drawn upward to fall into the hands of the men on the wharf and be sliced into great blocks two or three feet square (see page 412).

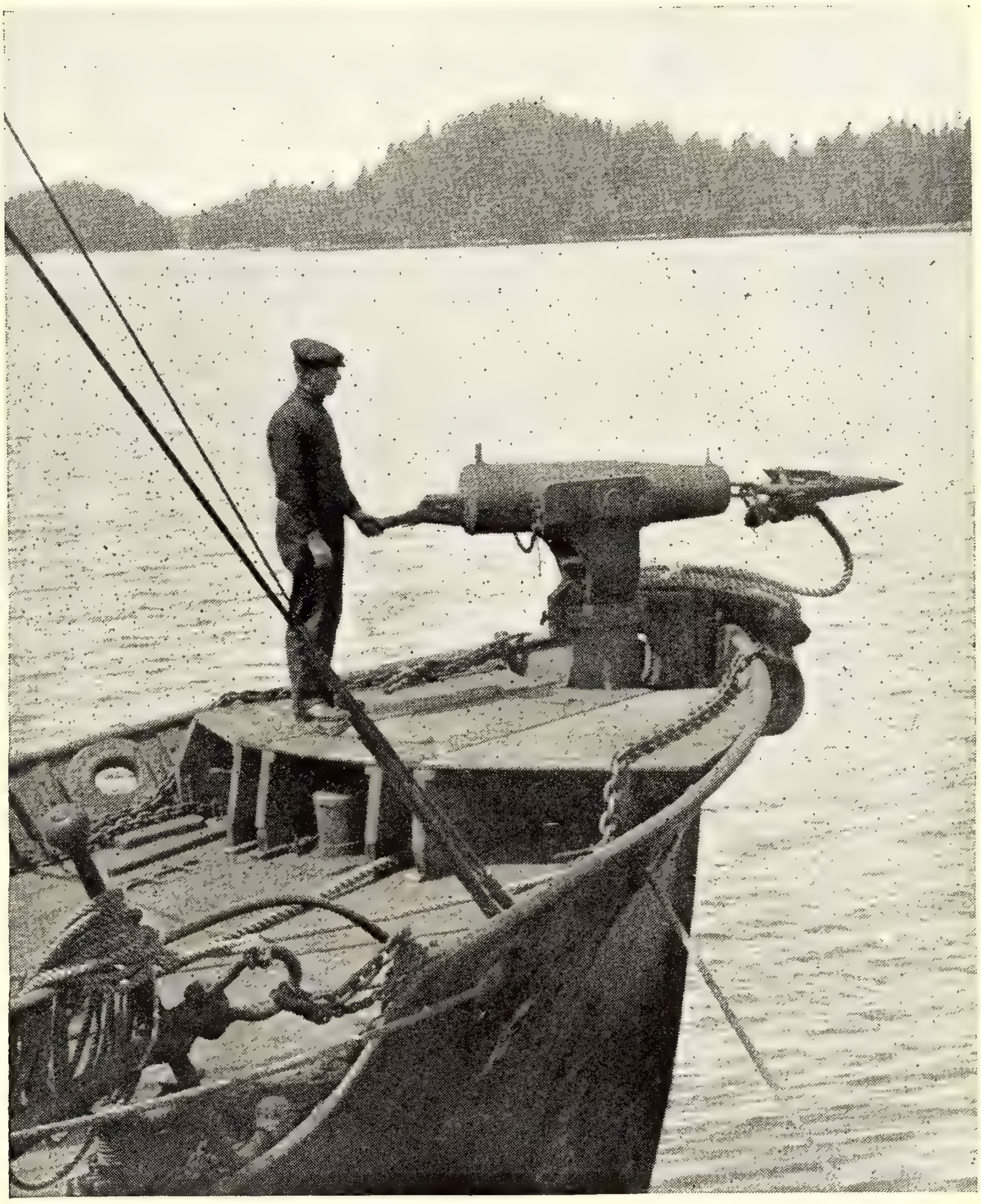


Photo by courtesy of World's Work

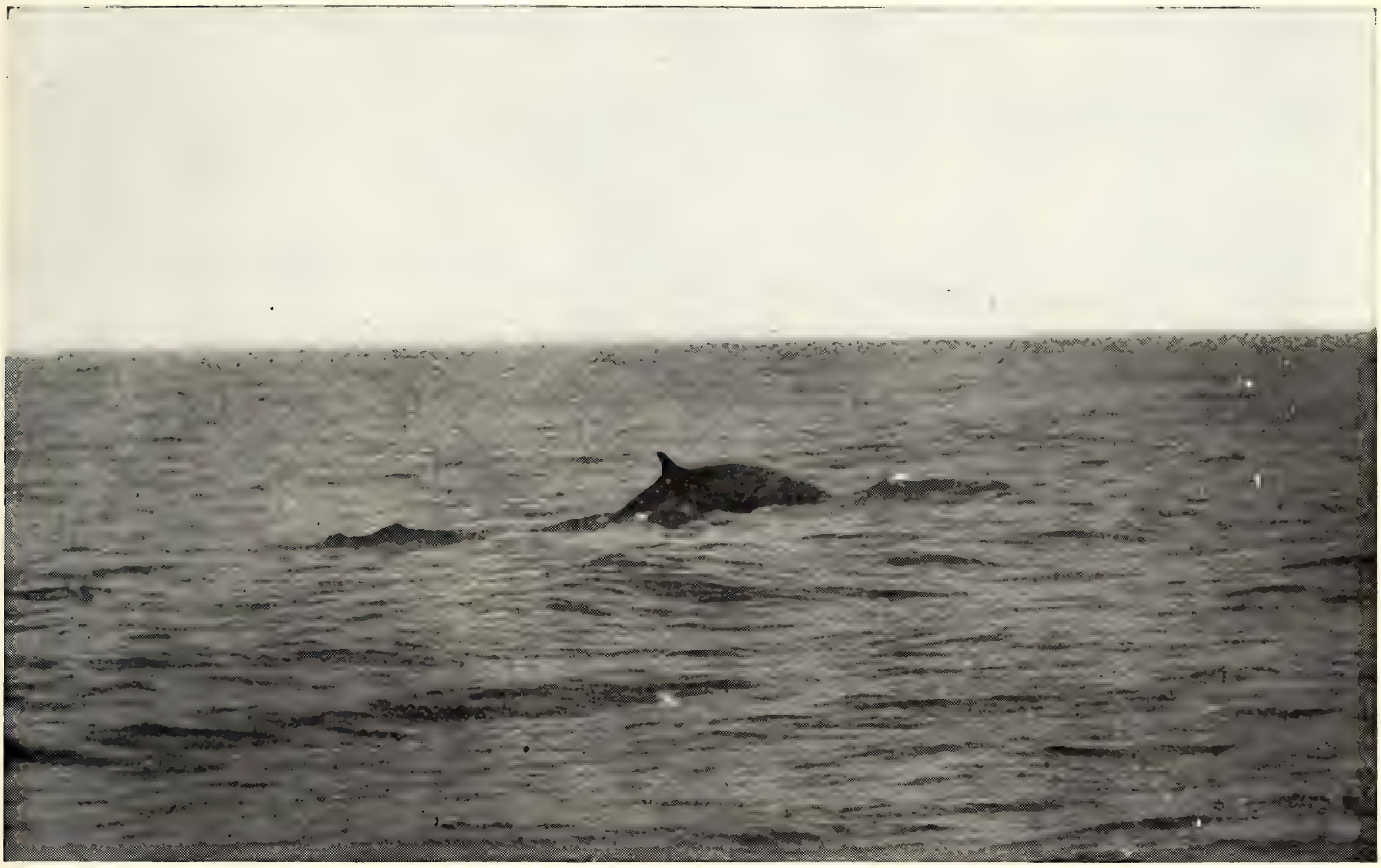
THE HARPOON GUN USED FOR KILLING AND CAPTURING WHALES (SEE PAGE 423)

The scene was one of "orderly confusion"—men, women, and girls laughing and chattering, running here and there, sometimes stopping for a few words of banter, but each with his, or her, own work to do. Above the babel of sounds, the strange, half-wild, meaningless chant, "Ya-rā-cū-ra-sa," rose and died away, swelling again in a fierce chorus as the sweating, half-naked men pulled and strained at a great jawbone or swung the hundred-pound chunks of flesh into the waiting hand-cars which carried them to the washing vats. Sometimes a kimona-clad, bare-footed girl slipped on the oily boards or treacherous, sliding, blubber cakes and sprawled into a great pool of blood, rising amid roars of laughter to shake herself, wipe the red blotches from her little stub nose, and go on as merrily as before.

It was essentially a good-natured crowd, working hard and ceaselessly, but deriving as much fun from their labor as though it was a holiday. The

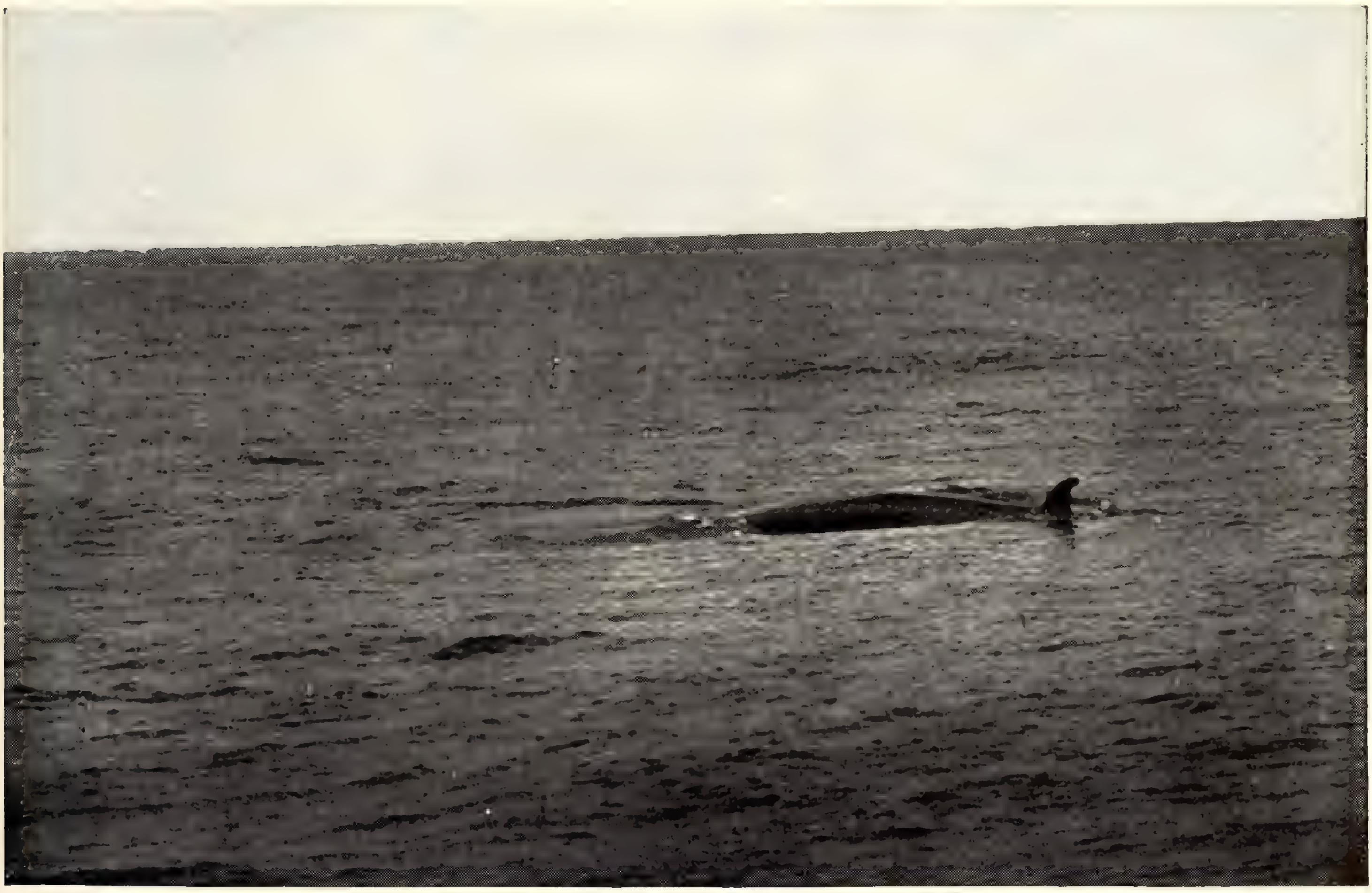
A SEI OR SARDINE WHALE SPOUTING: JAPAN

A SEI OR SARDINE WHALE INSPIRING (SEE PAGE 430)



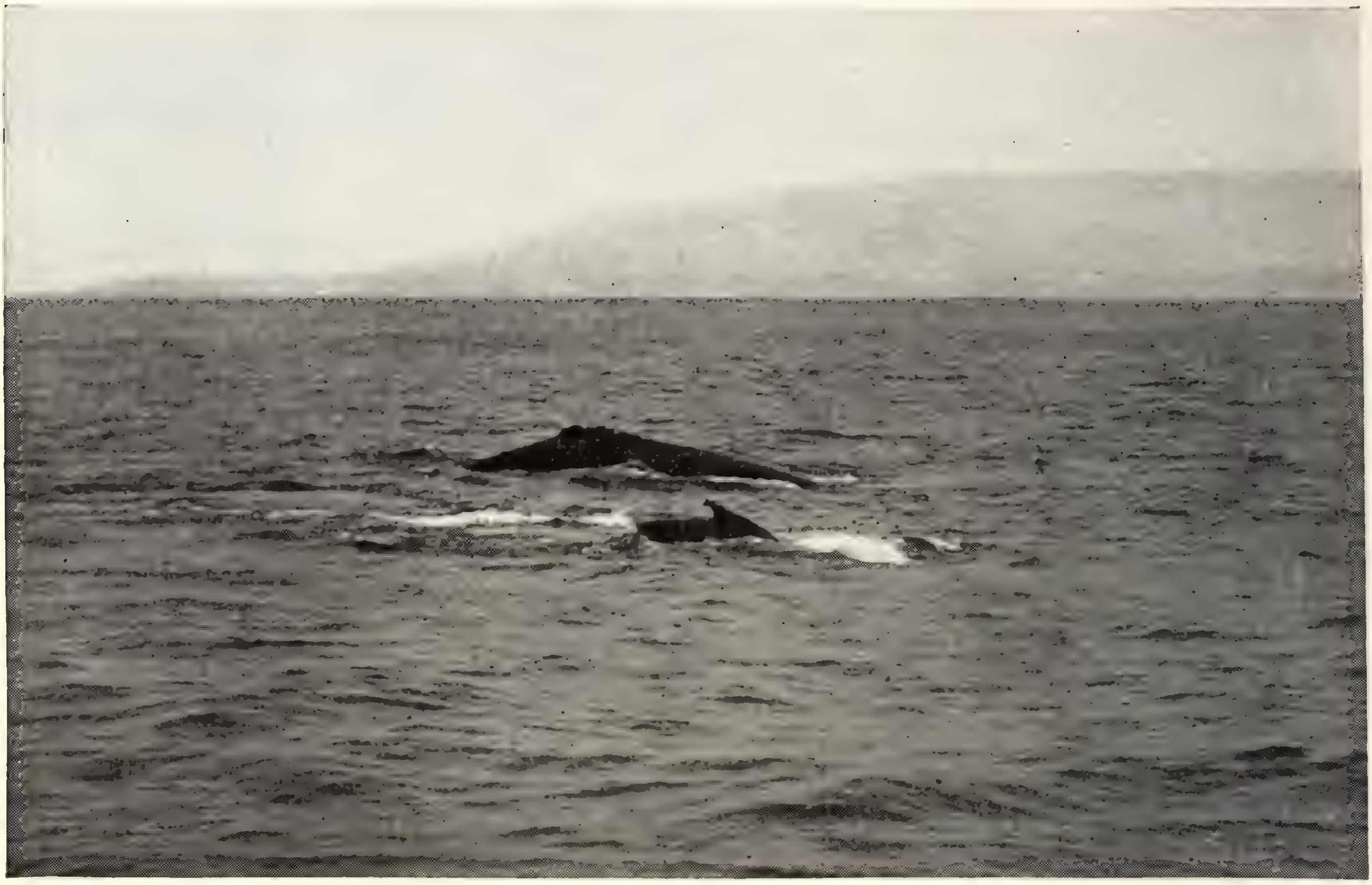
A FINBACK WHALE DIVING: JAPAN

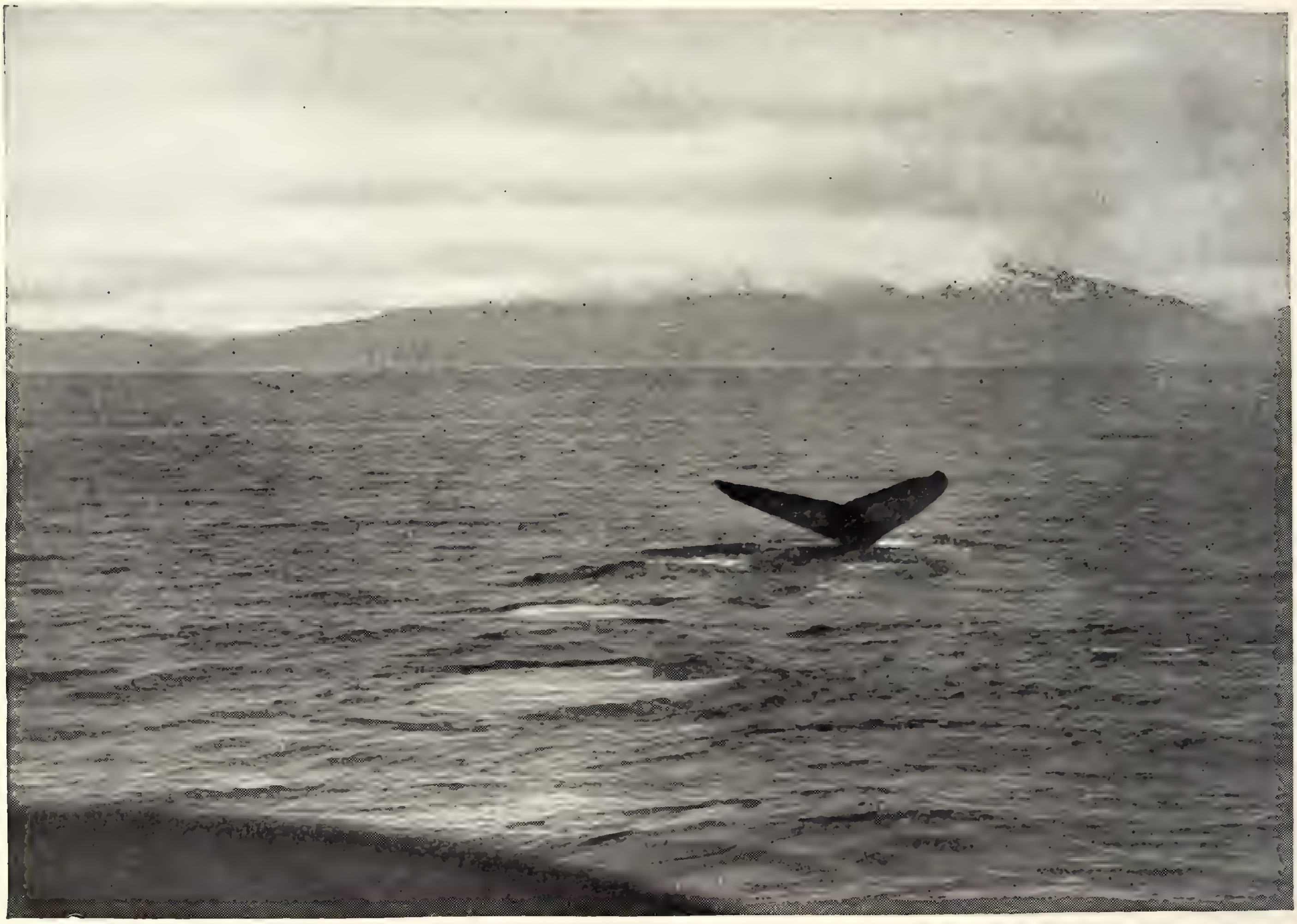
This species derives its name from the large fin on its back, and whch is clearly shown in this picture



SEI WHALE ABOUT TO TAKE A "SURFACE DIVE" (SEE PAGE 430)

This species may be easily recognized in the water by the height of the dorsal fin. "It is most interesting to watch these beautiful animals pursuing a school of sardines, twisting their lithe bodies as they whirl along after the terrified, skipping fish, sometimes throwing themselves half out of the water in their eagerness. But, like the other finners, they will always eat shrimp, if it is obtainable, in preference to anything else."

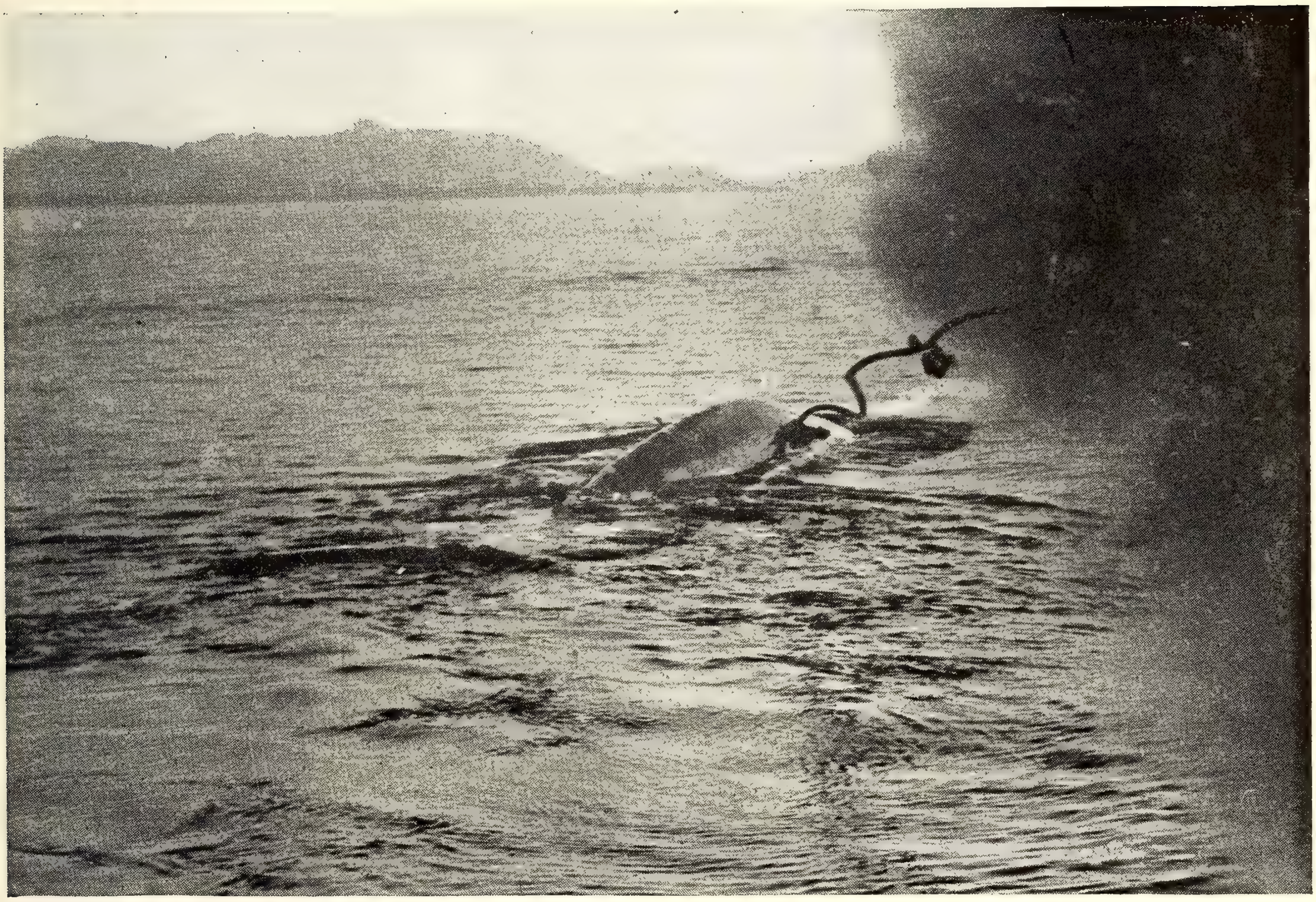




HUMPBACKS OFTEN SWIM IN PAIRS WHILE FEEDING

THE FLUKES OF A BIG HUMPBACK JUST DISAPPEARING BENEATH THE SURFACE

The smooth spot, or "slick," on the water is the invariable accompaniment of the dive.
Photos by courtesy of World's Work



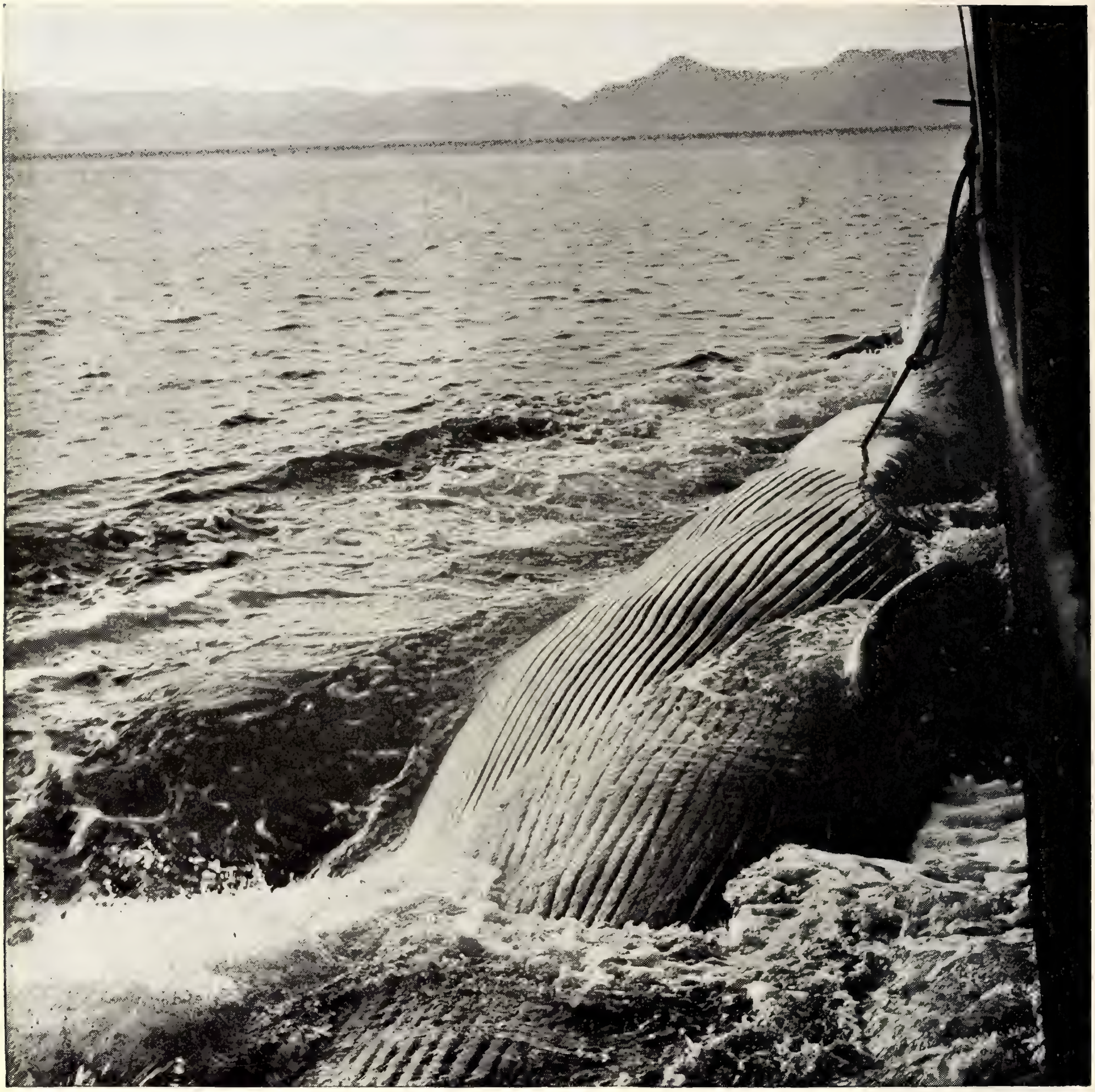
THE HARPOON AS IT STRIKES THE WHALE

In addition to the rope, the harpoon carries a bomb, which is exploded three or four feet inside the whale and usually kills the huge animal instantly. The black cloud is the smoke from the discharge.

spirit of the place was infectious, and as I splashed about in the blood and grease doing my own work, I talked and joked with the cutters in bad Japanese, causing screams of laughter when I seriously informed them that "the sun was very hot water" by the quite natural mistake of substituting the word "atsui-yu" for "atsui" (hot).

Almost every night we would be awakened by the long-drawn wail of a ship's siren whistle, bringing the news of more whales. If I did not at once stir, the little *amah* (servant), always devoted to my interests, would quietly slide back the paper screen to the sleeping-room and say, "*Andrews-sar Go Hogei wa kujira torri mashita*" (Hogei, No. 5 caught whales). When I had rolled out of the comfortable *futons* and begun to dress, I would hear little Scio-san pattering about in the other room, gathering my pencil, note-book, and tape measure. Looking like a beautiful night-moth in her bright-colored kimona, with the huge bow of her *obi* (sash) always neatly arranged, she would be there to help me into the greasy oil-skins and rubber boots, and clump along in front to the wharf, lighting the way with a "chōchin" (paper lantern) that I might not bump my head on the eaves and rafters of the low station sheds.

Every day Scio-san religiously went to her ugly little stone joss in the playhouse temple on the hillside and prayed that the "America-san" might catch many whales and porpoises for the *hakubutsu-kwan* (museum) in the wonderful, fairy city across the Pacific, of which he had so often told her. And when the season was ended and she had ventured to ask the America-san to himself thank the joss, and to please her



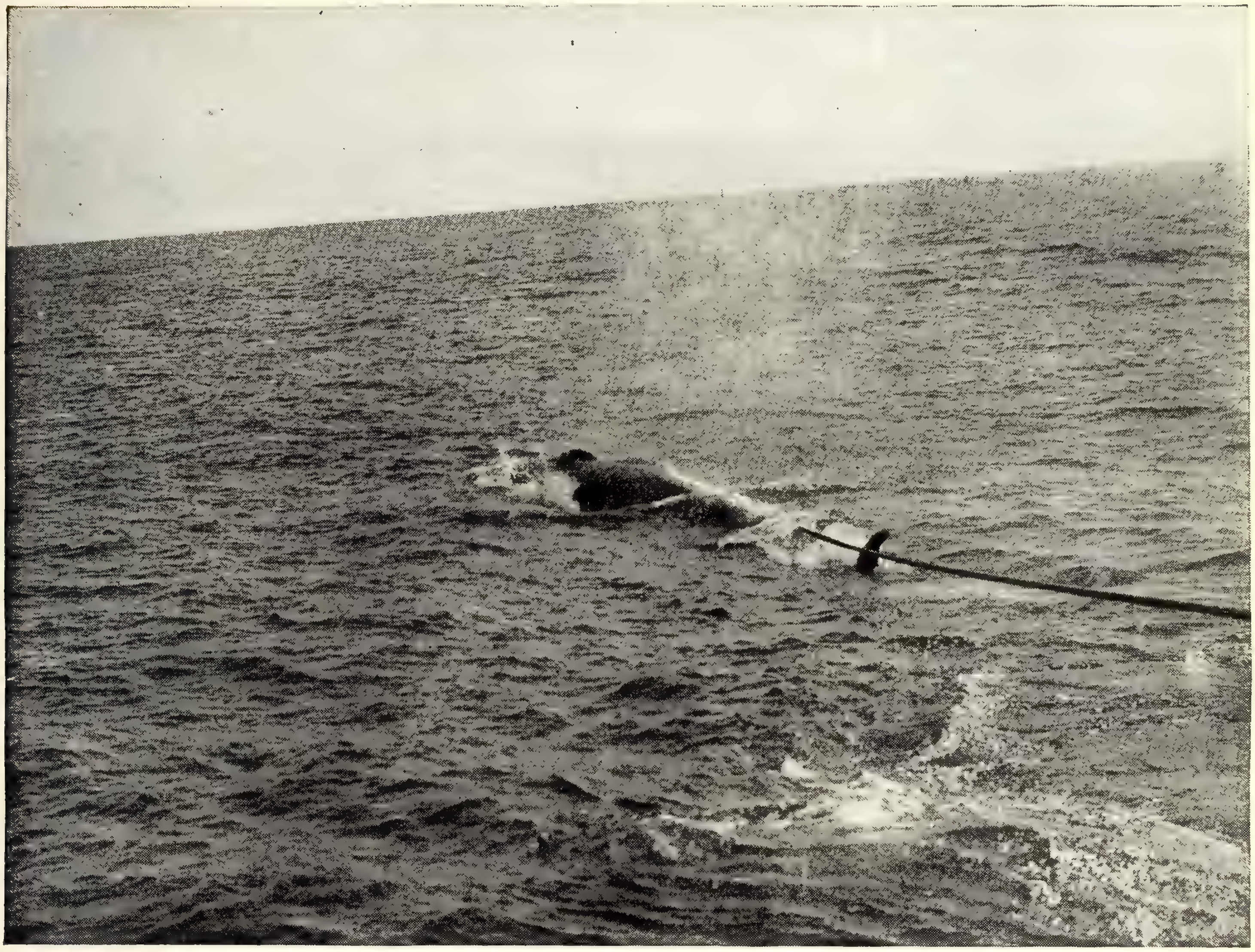
INFLATING THE CARCASS OF A HUMPBACK WHALE TO KEEP IT AFLOAT

A hollow steel tube is thrust into the whale's side and the animal is slowly filled with air by a steam pump. Photo by courtesy of World's Work

he had done so, her joy could hardly be contained, and the tip of her little nose was almost red from constant rubbing on the *tatami* (floor matting) in her bows of thanks and farewell.

Even though it was the very middle of the night when a ship's whistle sounded, long before the whale had been dropped at the wharf paper lanterns, flashing like fireflies, would begin to shine and disappear among the thatched-roofed cottages and a crowd of villagers gather at the end of the wharf. Half-naked men, child-faced geishas, and little youngsters carrying sleeping babies as large as themselves strapped to their backs, formed a curious, picturesque, ever-changing group.

Fires of coal-fat in iron racks along the wharf threw a brilliant yellow light far out over the bay filled with whale ships, heavy, square-sterned fishing boats, and sampans. The work of cutting in would go on as merrily as in the day-



TOWING THE INFLATED WHALE TO THE FACTORY

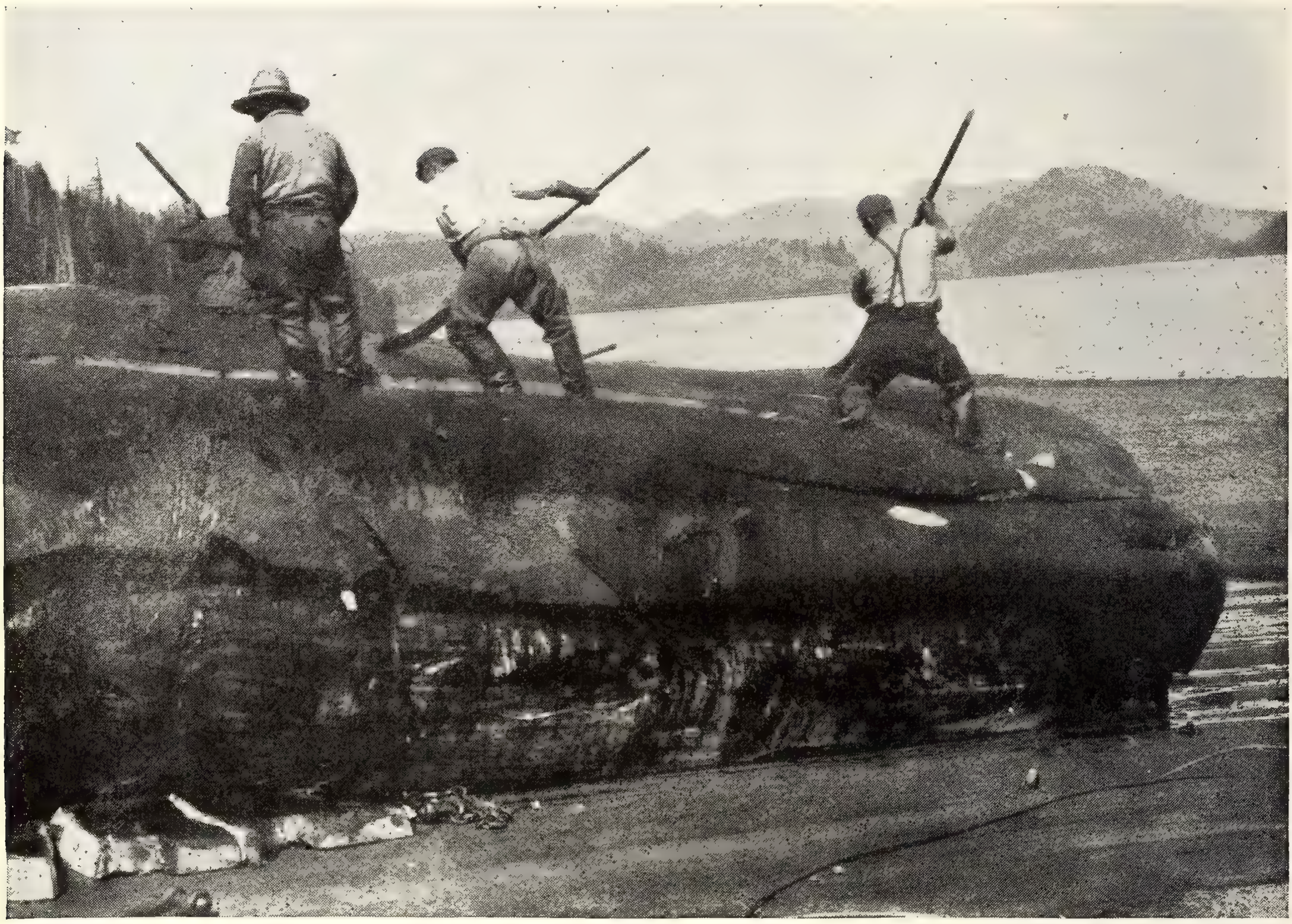
time, for the meat and blubber must be hurried on board fast transports and sent to the nearest city, to be sold in the markets and peddled from house to house.

WHALE MEAT IS VERY POPULAR IN JAPAN

Few people realize the great part which whale meat plays in the life of the ordinary Japanese. Too poor to buy beef, their diet would include little but rice, fish, and vegetables were it not for the great supply of flesh and blubber furnished by these huge water mammals. In winter the meat of the humpback whale, which is most highly esteemed, sometimes brings as much as 30 *sen* (15 cents) per pound; but this is unusual. Ordinarily it can be bought for 15 *sen* or less. But the edible portions are not only the flesh and blubber. Certain parts of the viscera are prepared for human consumption, and what remains is first tried out to extract the oil, then chipped by girls using hand-knives, and dried in the sun for fertilizer.

Whale meat is very coarse grained and tastes something like venison, but has a flavor peculiarly its own. I have eaten it for many days in succession, and found it not only palatable but healthful. The Japanese prepare it in a variety of ways, but perhaps it is most frequently chopped finely, mixed with vegetables, and eaten raw, dressed with a brown sauce.

In the summer, when it is impossible to ship the meat to any distance because of the heat, much of it is canned. The flesh is cooked in great kettles, and the cans made, packed, and labeled at the stations. On my desk as I write is a tin of whale meat which I brought from Aikawa, where hundreds of pounds were



THE FLENSERS AT WORK ON A SPERM WHALE'S HEAD: VANCOUVER

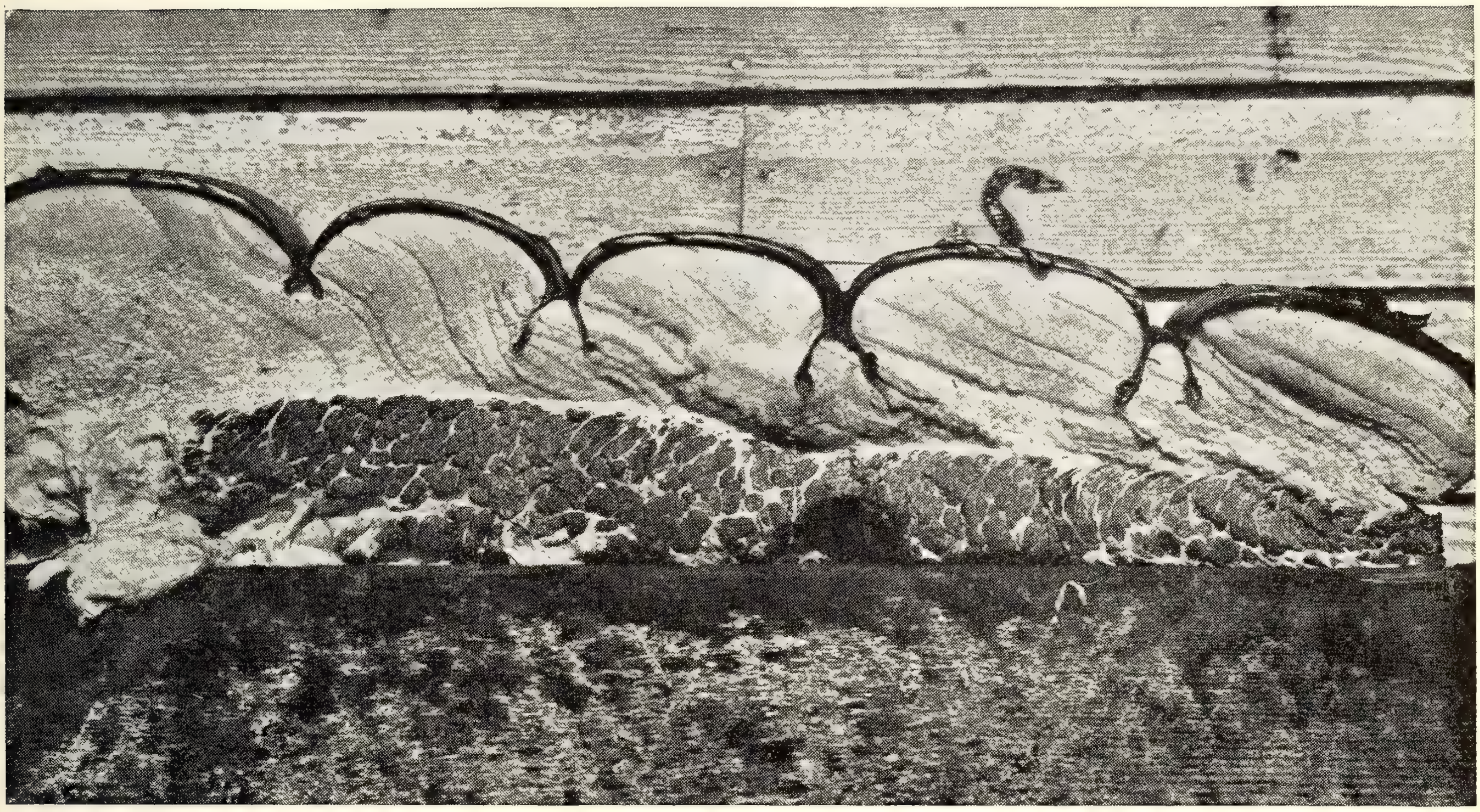
"They make longitudinal incisions through the blubber along the breast, side, and back, and from the flukes the entire length of the body to the head. The cable was then made fast to the blubber at the chin, the winch started, and the great layer of fat stripped off exactly as one would peel an orange" (see page 414).

packed and sent southward to be marketed at Tokyo and shipped to all parts of the Empire.

It is most unfortunate that prejudice prevents whale meat from being sold in Europe and America. It could not, of course, be sent fresh to the large cities; but, canned in the Japanese fashion, it is vastly superior to much of the beef and other tinned foods now on sale in our markets. In New Zealand the Messrs. Cook Brothers, who have developed a most extraordinary method of capturing humpback whales in wire nets, can a great deal of meat and ship it to the South Sea Islands, where it is sold to the natives.

The baleen of the rorquals, which is of little value in Europe and America, has been put to many uses by the Japanese. When I visited the exhibition rooms of the Toyo Hogei Kaisha, in Tokyo, I was astonished and delighted at sight of the cigar and cigarette cases, charcoal baskets, sandals, and other beautiful things created by their clever brains and skillful fingers from the material which, in the hands of western nations, seems to be useless.

The whales are going fast, and it is probable that long before the slow-moving wheels of government begin to revolve and legislation is enacted for their protection, they will have become commercially extinct. But since this seems to be unavoidable, my hopes are that the Japanese will get even more than their share while they do last. There the whales are as carefully prepared and utilized for as great a purpose as are



CROSS-SECTION OF BLUBBER ON BREAST OF WHALE, SHOWING THE FOLDS (SEE P. 414)

cattle and sheep in the Occident. In other countries but little of the real value of the animals is secured, and their great bodies are being spread upon the southern cotton fields instead of feeding thousands of hungry poor.

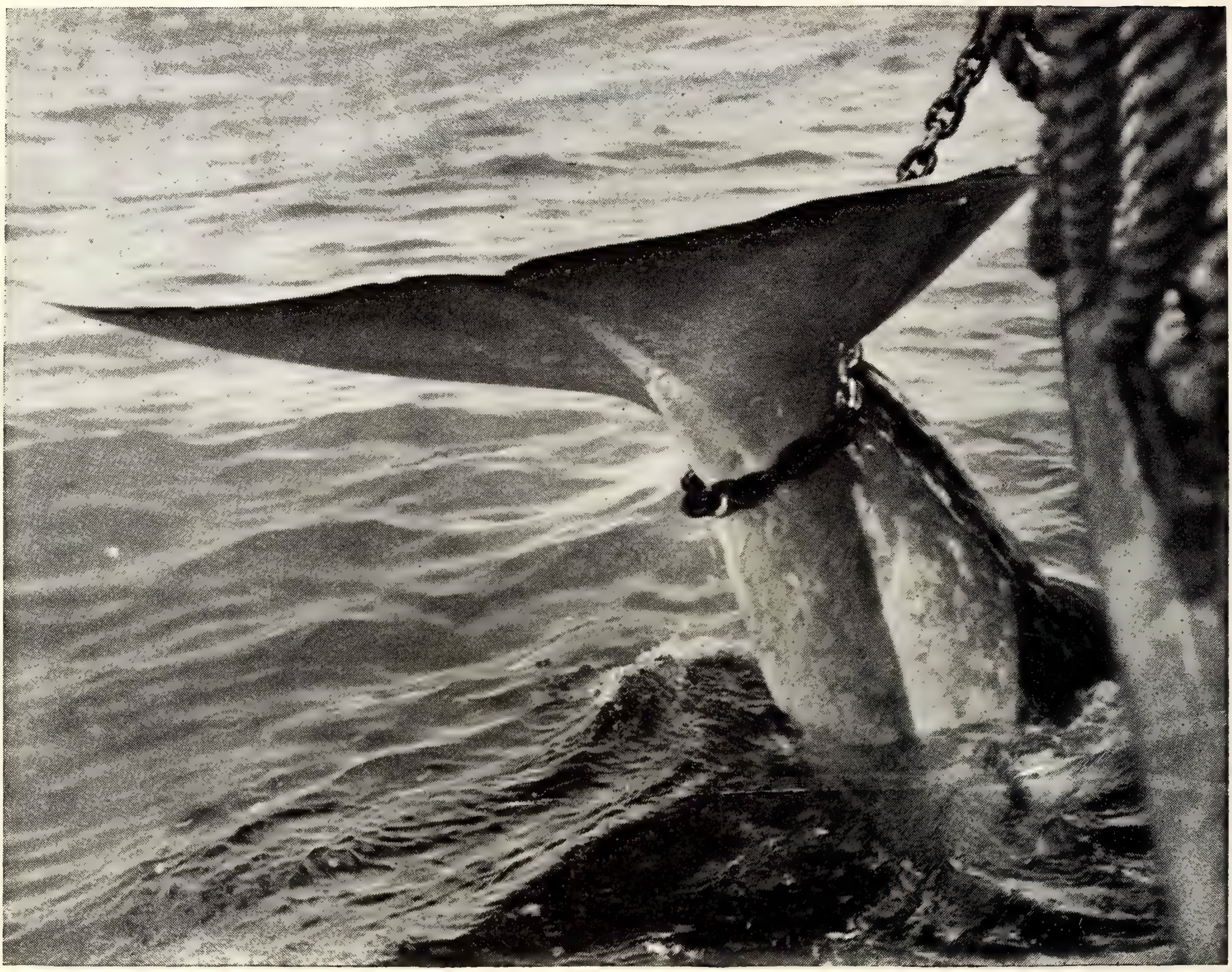
THE BLUE WHALE

I have been writing of the methods of preparing whales, but have told little of the animals themselves. Few readers, perhaps, realize that the blue, or sulphur-bottom, whale found in all our oceans is not only the largest animal that lives today, but is also, so far as is now known, the largest animal that has ever existed on the earth or in its waters. Specimens have been measured which reached a length of 87 feet and in all probability weighed as much as 75 tons. Although the mouth is enormous, large enough in fact to permit 10 or 12 men to stand upright in it, the throat measures only about 9 inches in diameter (see p. 412).

These animals, like most of the "whalebone whales," usually feed on minute crustaceans, a shrimp about three-quarters of an inch long. They probably never eat fish of any kind if other food is to be had, and of the many stomachs which I have examined, never once could anything but the little red crustaceans be found. From the stomach of one blue whale at Vancouver Island five barrels (1,215 pounds) of shrimp were taken, and it was by no means full.

The Norwegians gave the animal the name of blue whale from the bluish cast to the beautiful gray body. Sulphur-bottom, as the whale is called at the American stations, is a misnomer and unfortunate, for there is not the slightest trace of yellowish color anywhere upon the animal.

Probably no cetacean has such wonderful strength as have the blue whales. I have heard many stories of the almost incredible way in which these animals can pull, but was at first inclined to doubt them. Later, when I saw a blue whale with a harpoon between the shoulders drag the ship, with engines at full speed astern, through the water almost as though it had been a rowboat, I began to listen with more respect. Since the tail is used almost exclusively for propelling the animal forward, if the iron strikes far back the whale is greatly



MAKING A WHALE FAST TO THE SIDE OF THE SHIP: JAPAN

hampered in its swimming movements; but with the harpoon between its shoulders it can pull with all its strength.

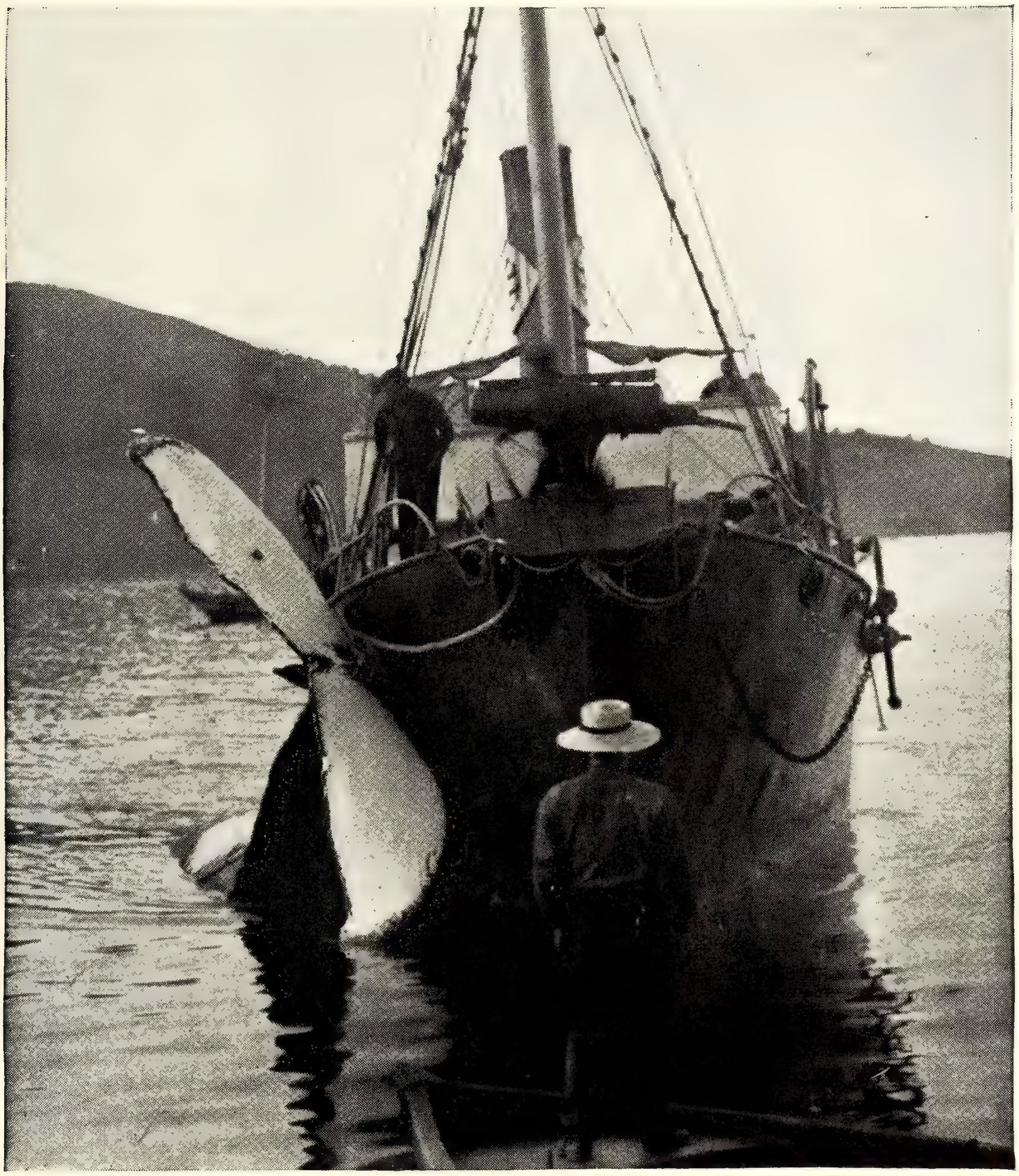
THE FINBACK, OR "GREYHOUND OF THE SEA" (SEE PAGE 437)

The finback, closely related to the blue whale, has been called the "greyhound of the sea," for its long, slender body is built on the lines of a racing yacht and the animal can equal the speed of the fastest steamship. The back is dark gray, shading into beautiful light gray on the sides and pure white below. A noticeable character about this whale is the asymetry of the throat coloring; the left side is dark slate and the right pure white like the under parts. The baleen, also, on the right side, for a distance of about 2½ feet, is white, in sharp distinction from the remaining dark places.

THE HUMPBACK IS VERY PLAYFUL

The humpback is to me the most interesting of all our large whales, partly because of the fact that its habits are more easily studied than are those of the other members of the family. Its maximum size is under 55 feet, but its body is thick and heavy, with enormous side fins, or flippers. These great paddles are one-quarter the length of the entire body and a single one from a whale 49 feet long weighed on the station scales 956 pounds. The throat, breast, flukes, and flippers of the humpback are almost invariably covered with masses of barnacles, or rather barnacles on barnacles, for the hard, shell-like *Coronula* are themselves the hosts of the soft, pendant goose barnacles (see page 417).

Barnacles are not the only parasites which infest these animals, for the hump-



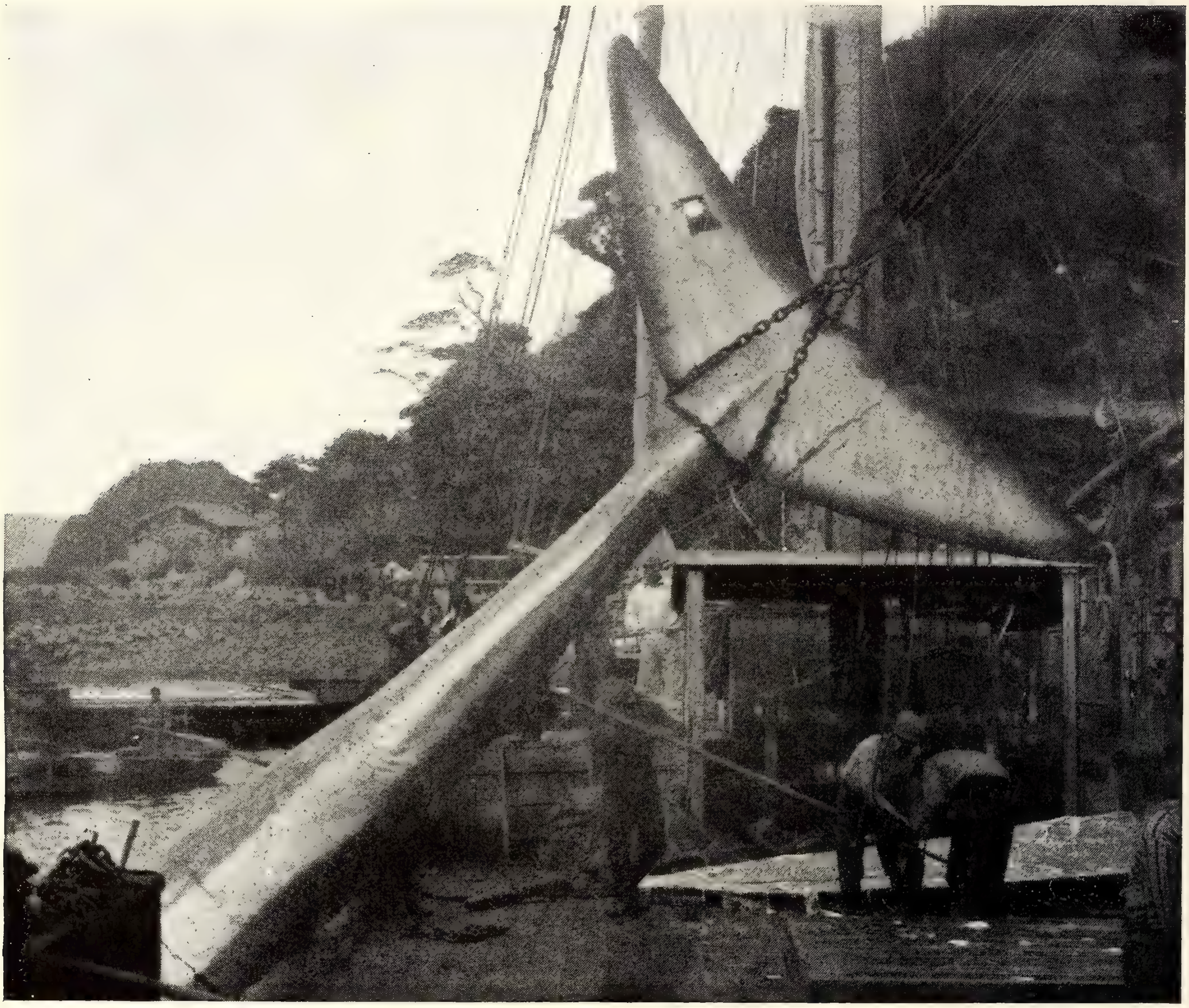
BRINGING IN A HUMPBACK: JAPAN

This is not a propeller, but the whale's tail

backs, and in fact almost all the large whales, bear numbers of crab-like crustaceans (*Cyamus*), about half an inch in length, called "whale lice." On the right whales these "lice" produce such an irritation upon the top of the snout that a large, irregular roughened patch, called the "bonnet," is formed; on the side of the lip and over the eyes are other and smaller patches infested with the troublesome crustaceans.

The most playful of all our large whales are the humpbacks, and consequently they are the most interesting to the photographer. Jumping or "breaching" is one of their most spectacular performances, and it is truly a wonderful sight. The first time I ever saw a humpback "breach" was off the Vancouver Island coast while on board the ship *Orion*. We had sighted a lone bull whale late in the afternoon, and for two hours the little ship had been hanging doggedly to the chase.

The whale seemed to know exactly the number of fathoms at which the harpoon gun was effective and gauged the distance accurately, always coming up just

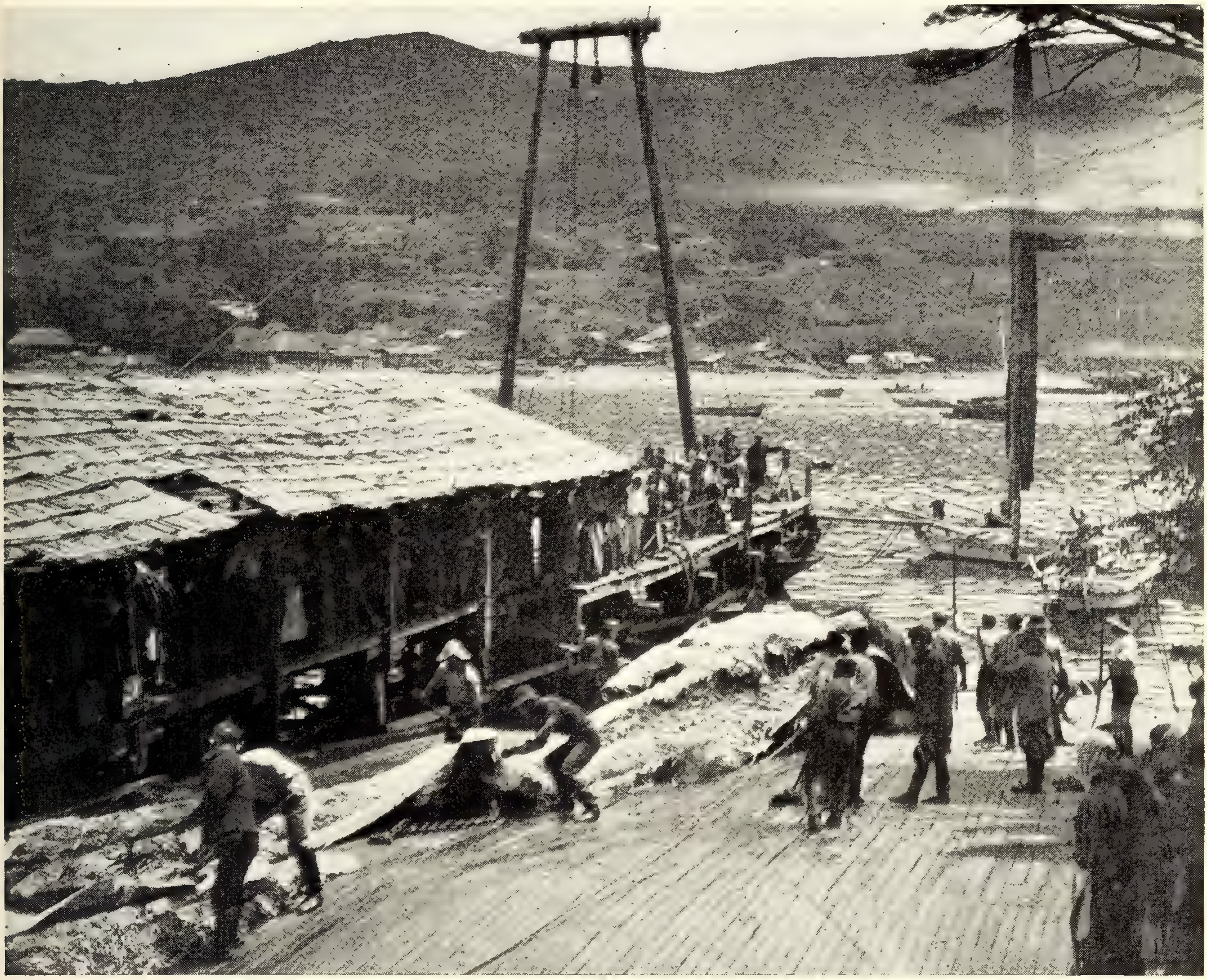


DRAWING A FINBACK UP ON THE WAYS TO BE CUT UP: JAPAN

out of range. Sometimes the animal thrust its entire head and fore part of the body out of the water, with a loud, whistling spout, sinking back out of sight before the ship could swing about. Again, it inverted itself and, with the entire posterior part out of the water, began to wave the gigantic flukes back and forth. The motion was slow and dignified at first, the flukes not touching the water on either side. Faster and faster they waved, until they were lashing the water into foam and sending clouds of spray high into the air; then slowly the action ceased and the whale sank out of sight. The ship was not far from the animal as it went down and I stood waiting on the gun platform, when suddenly the water parted directly in front of us and with a rush that sent its huge, black body five feet clear of the surface the whale shot into the air, fins extended, and fell back on its side, sinking slowly out of sight amid a perfect cloud of spray.

THE SEI, OR SARDINE WHALE

While in Japan during 1910 I had an opportunity to study in considerable detail a species which has never before been reported in numbers from the North Pacific. This is the sei whale of the Norwegians and the "Iwashi kujira" (sardine whale) of the Japanese. It is not a large animal, seldom exceeding 54 feet, and is formed on slender, graceful lines, much like the finback. Its coloration also resembles in a general way the



STRIPPING THE FLESH FROM THE SKELETON OF A GIANT FINBACK WHALE: JAPAN

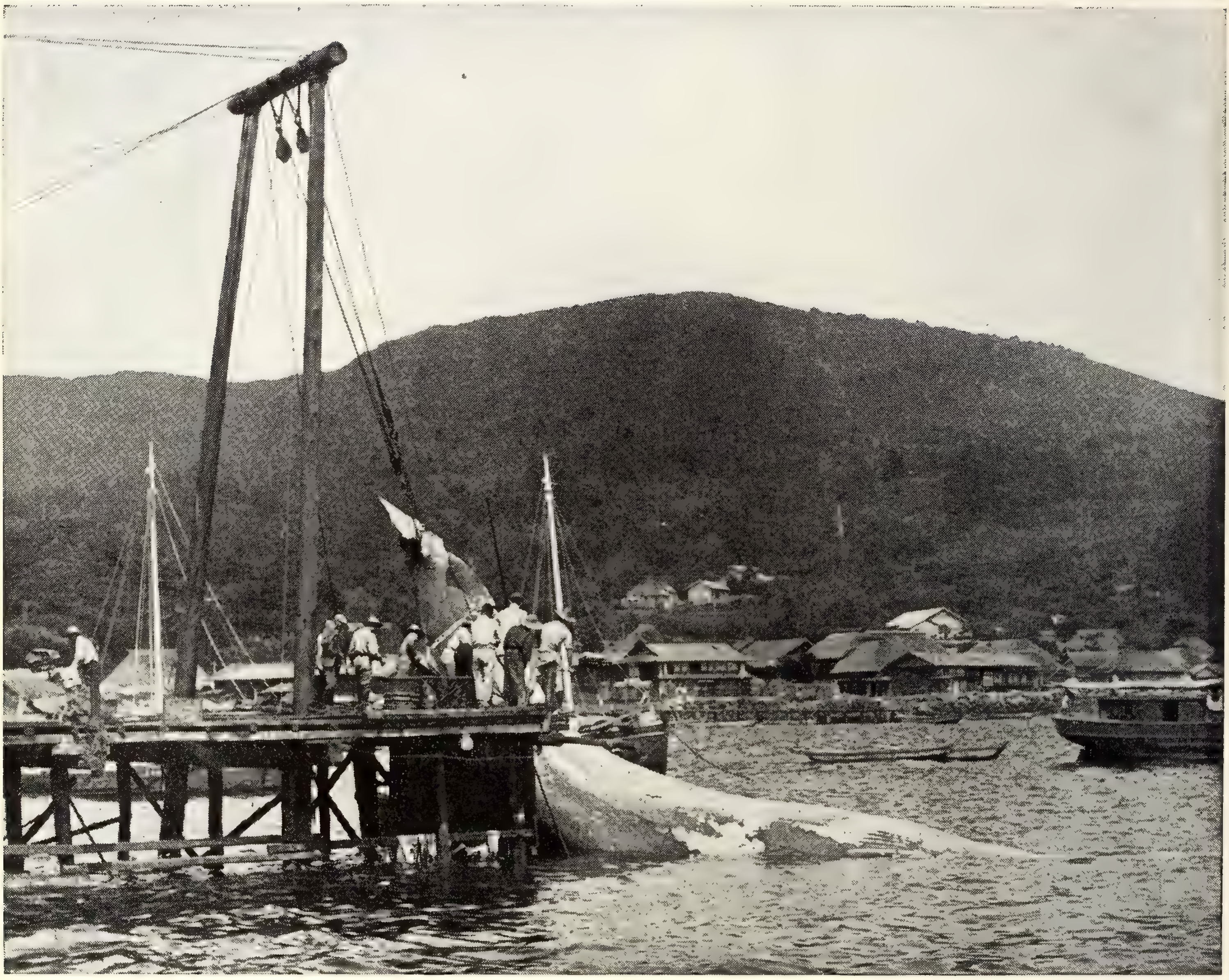
latter species, but it can be readily distinguished by its high, falcate dorsal fin.

The sei whale has a habit of swimming just below the surface, sometimes with the dorsal fin exposed, and when feeding will travel for a considerable distance in this manner. It is a difficult whale to shoot, because the back is arched but slightly when the animal dives and only a comparatively small part of its body is shown above the water at one time. I have seen a sardine whale, rising almost under the bows of a ship, suddenly check its upward rush and dash along just below the surface, the vessel going at full speed beside it in order to be within range when it finally rose to spout (see pages 420 and 421).

It is most interesting to watch these beautiful animals pursuing a school of sardines, twisting their lithe bodies as they whirl along after the terrified, skipping fish, sometimes throwing themselves half out of the water in their eagerness. But, like the other finners, they will always eat shrimp, if it is obtainable, in preference to anything else.

WHALES ARE DEVOTED TO THEIR CALVES

All the large whales show great affection for their young, and the cows and calves will seldom leave each other when pursued by a ship. I remember at one time in Alaska, on board the steamship *Tyee, Jr.*, we had sighted a female finback with a young one about 30 feet long beside her. They were not difficult to approach, and as the old whale rose

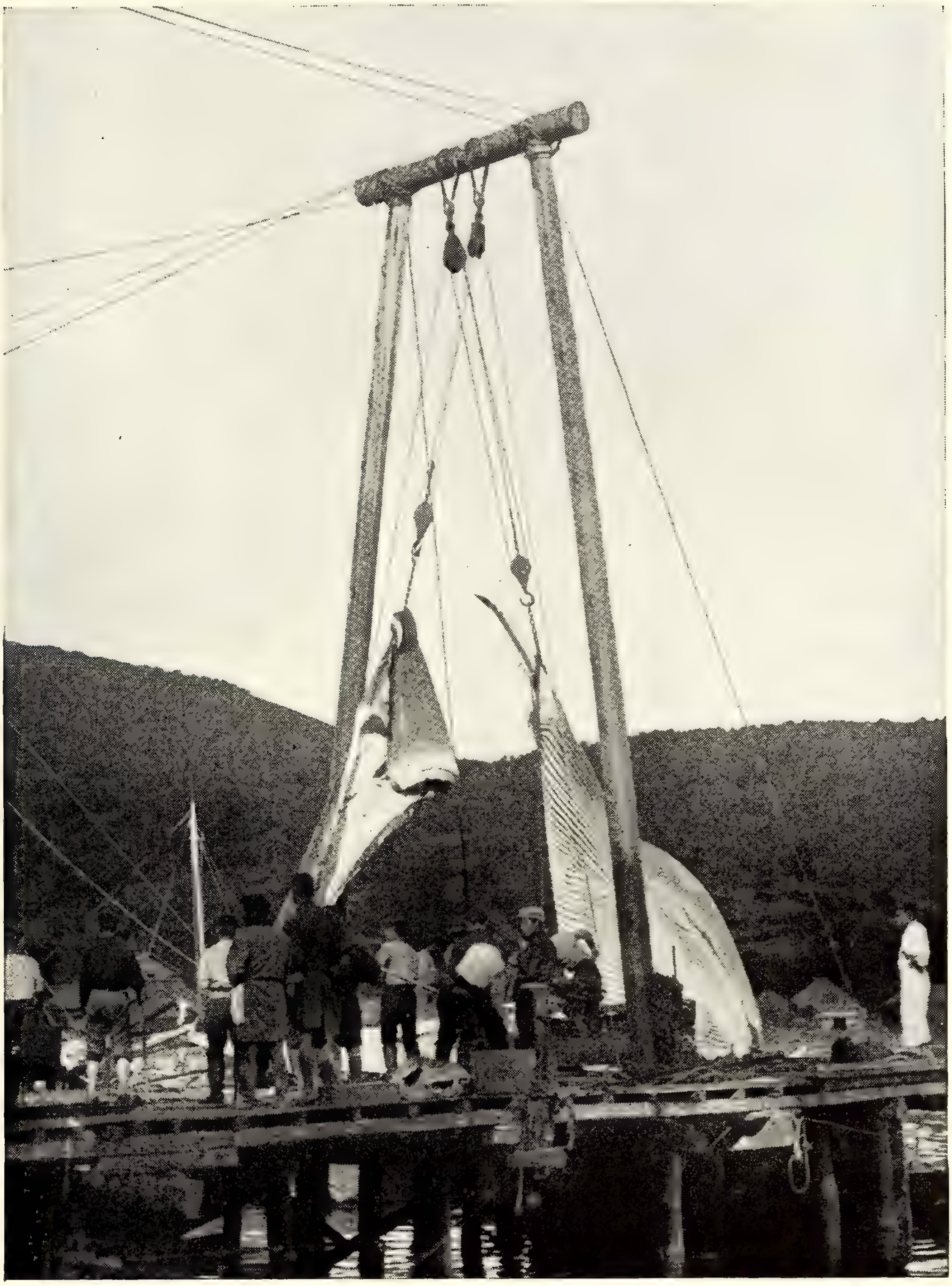


LIFTING A GIANT FINBACK WHALE OUT OF THE WATER SO THAT THE CUTTERS CAN GET AT IT (SEE PAGE 433)

to spout not five fathoms from the vessel's nose, the gunner fired, killing her almost instantly. The calf, although badly frightened, continued to swim in a circle about the ship, and finally, when its dead mother had been hoisted to the surface, the little fellow came alongside so close that I could have struck him with a stone. During the time that the carcass was being inflated and the gun reloaded, the calf was constantly within a few fathoms of the ship, swimming around and around, sometimes rubbing itself against the body of its dead mother. Finally a harpoon was sent crashing into its side, and it sank without a struggle.

PECULIARITIES OF WHALES

The feeding operations of the humpback, blue, and finback whales are carried on in essentially the same way and are most interesting to watch. If the "feed" happens to be floating at the surface, as is frequently the case in the morning and evening, the action can be easily seen. The whale opens its mouth, takes in a great quantity of water containing numbers of the floating shrimp, turns on its side, and brings the ponderous lower jaw upward, closing the mouth. The great, flexible tongue, filling the space between the rows of baleen, forces out the water, leaving the little shrimp, which have been strained out by the bristles on the inner side of the whalebone plates. The fin and one lobe of the flukes are thrust into the air as the mouth is closed, and sometimes the animal rolls from side to side. At this time the whales are careless of danger

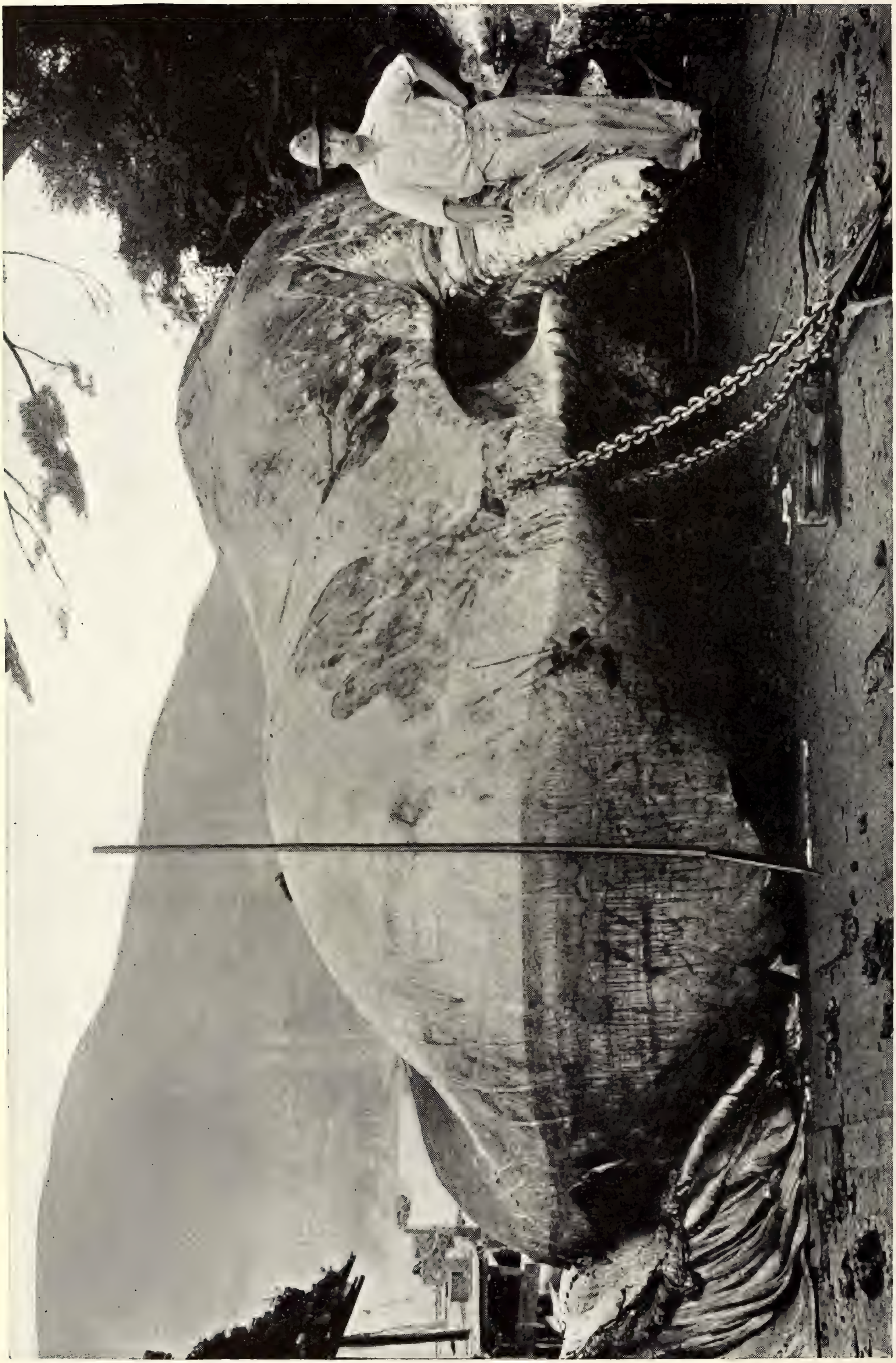


HOISTING ON THE WHARF PARTS OF THE WHALE SHOWN IN THE PRECEDING PICTURE

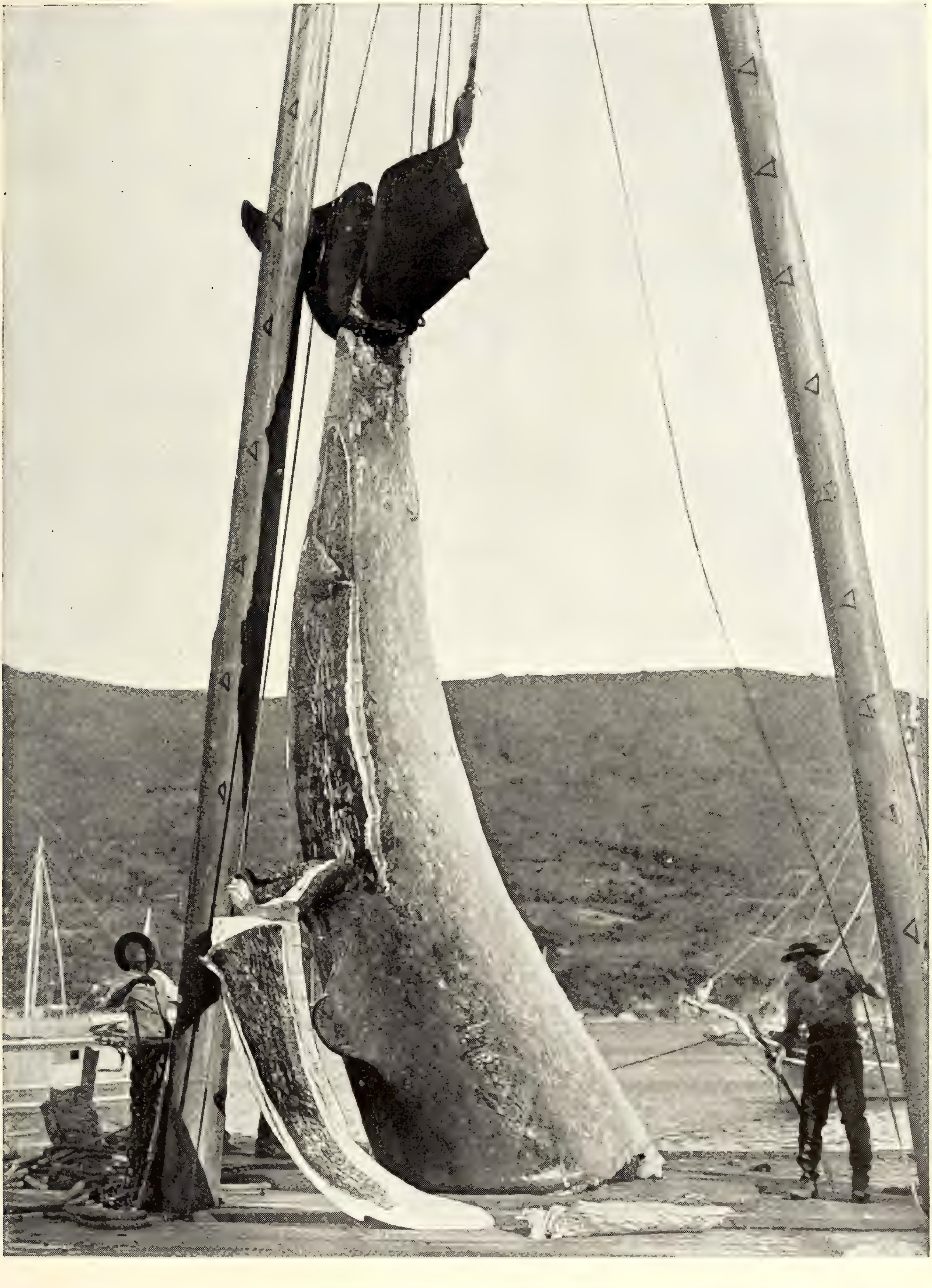
and pay not the slightest attention to the ship which is hunting them.

The distance traversed by whales when beneath the surface depends entirely upon circumstances. When there is little feed and the animals are constantly moving or "traveling," they may rise to spout several miles from the place of last appearance. If, on the contrary, feed is abundant, they may blow again within a short distance of the point at which they disappeared, and continue for several hours within two or three miles of the same spot.

There is a belief current among fishermen that whales can remain under water for a very long time without coming to the surface. This owes its origin to the fact that whales will suddenly appear when for hours before there had been no sign of a spout, even at a distance. I believe this idea may be accounted for by the hypothesis that the animals frequently swim great distances at considerable speed without appearing to blow. The longest period of submergence for finbacks which I actually timed by my watch was 23 minutes, but

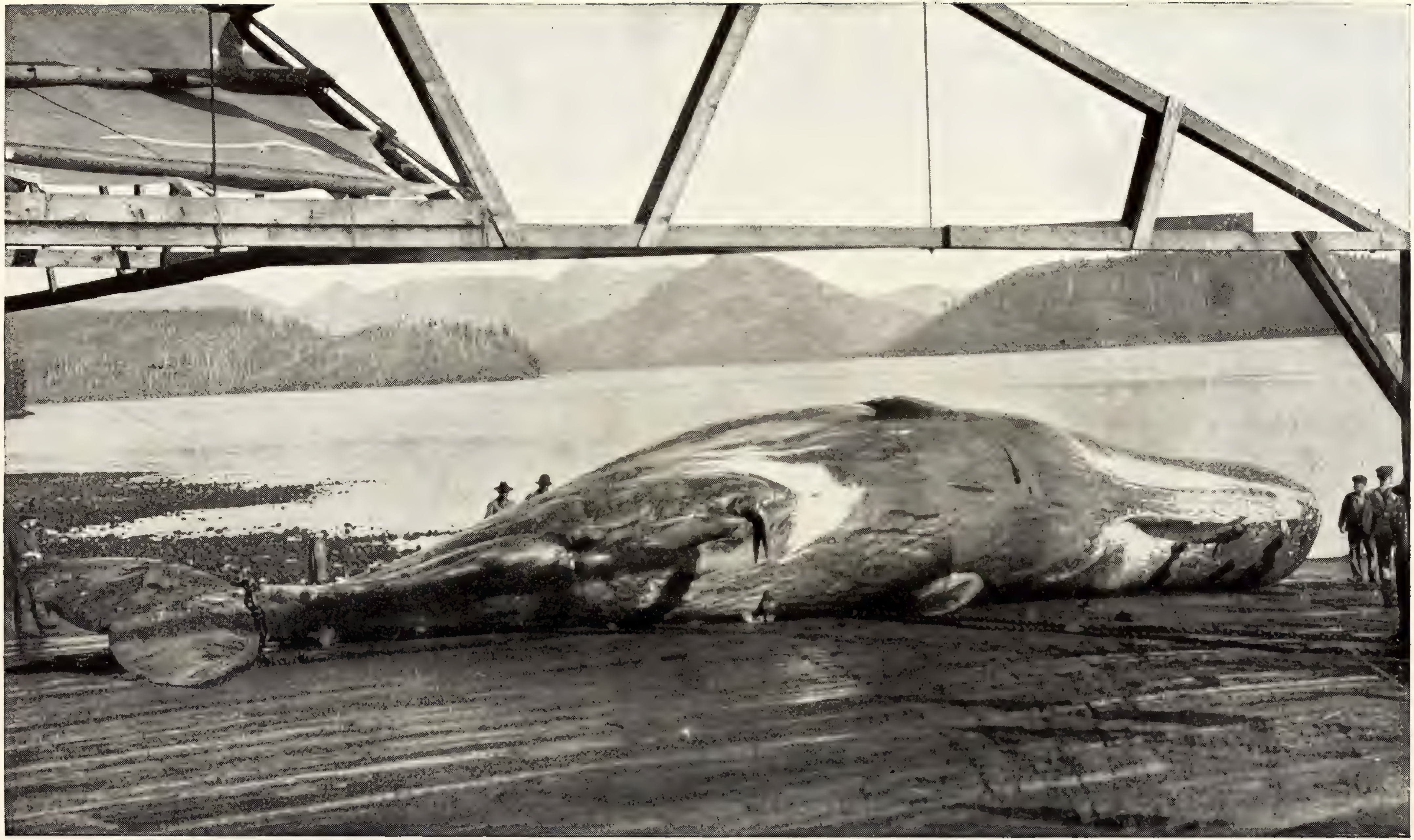


HEAD OF THE 60-FOOT SPERM WHALE SENT TO THE AMERICAN MUSEUM IN NEW YORK: THIS HEAD YIELDED 20 BARRELS OF SPERMACETI (SEE PAGE 442)



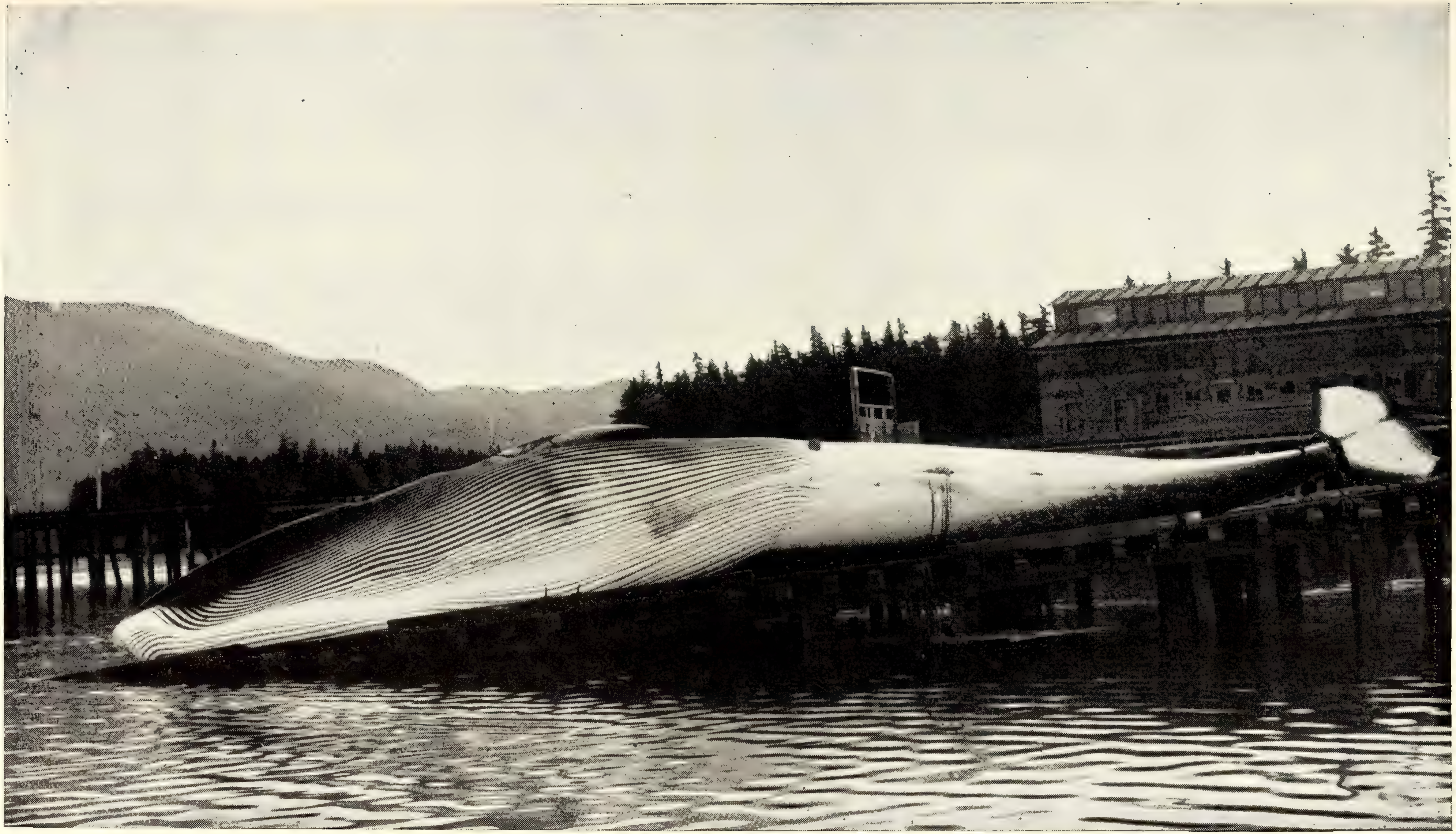
POSTERIOR PART OF A SEI OR SARDINE WHALE DRAWN UPON THE WHARF: JAPAN

This picture shows very distinctly the layer of blubber, or fat, which covers the entire body of all whales—the white layer enveloping the dark flesh (see page 414)



A BIG BULL SPERM WHALE: VANCOUVER ISLAND (SEE PAGES 434, 438, AND 439)

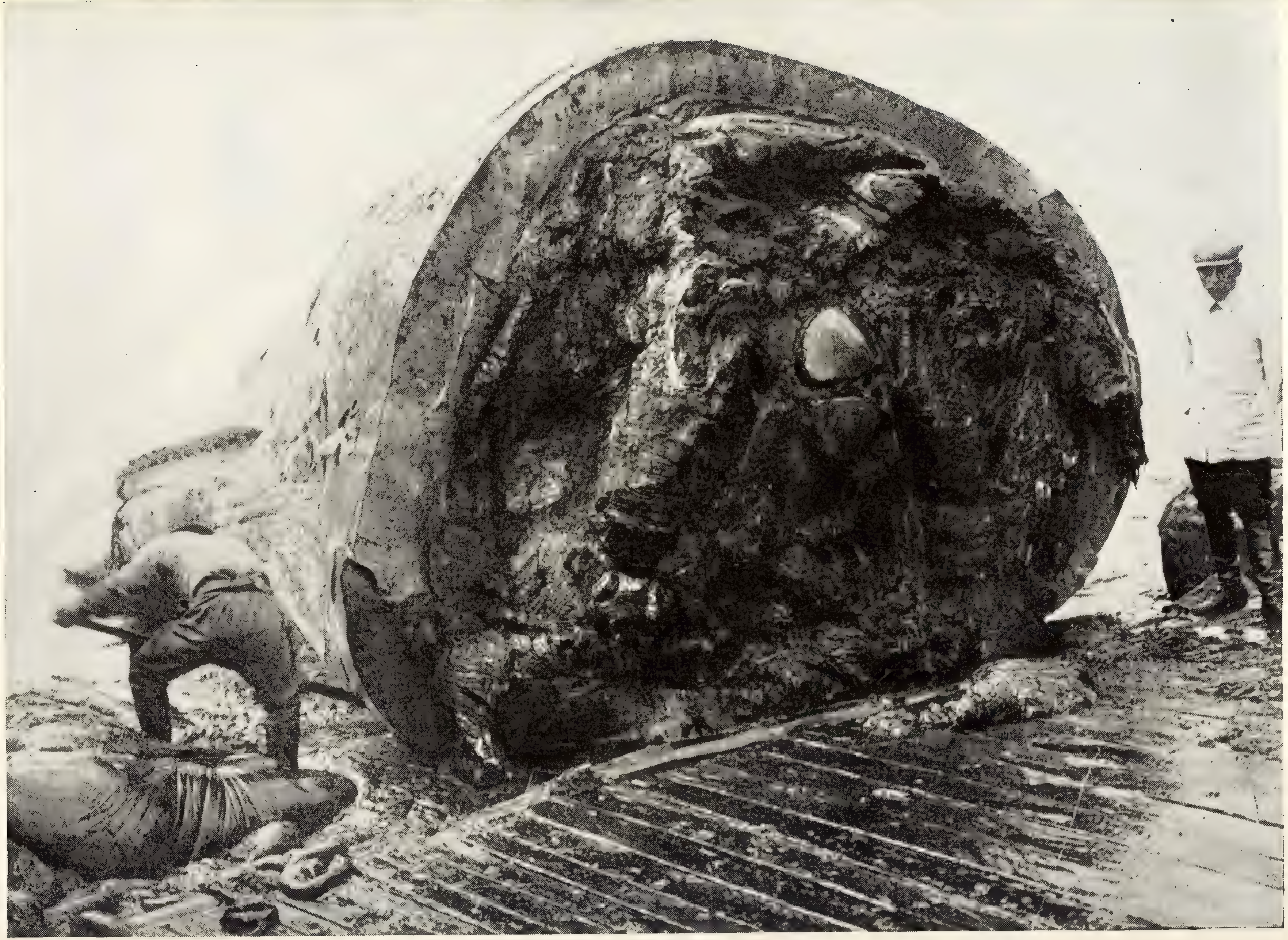
"The sperm whale is the animal which yields ambergris, the valuable substance used so extensively in the manufacture of our best perfumes. Ambergris is only found in 'sick' whales; that is, its presence is not normal, but is caused by a pathological condition of the intestines." Contrast the huge head and bulky frame of this species with the "racing build" of the finback whale in the next picture.



THE GREYHOUND OF THE SEA: A FEMALE FINBACK WHALE: ALASKA

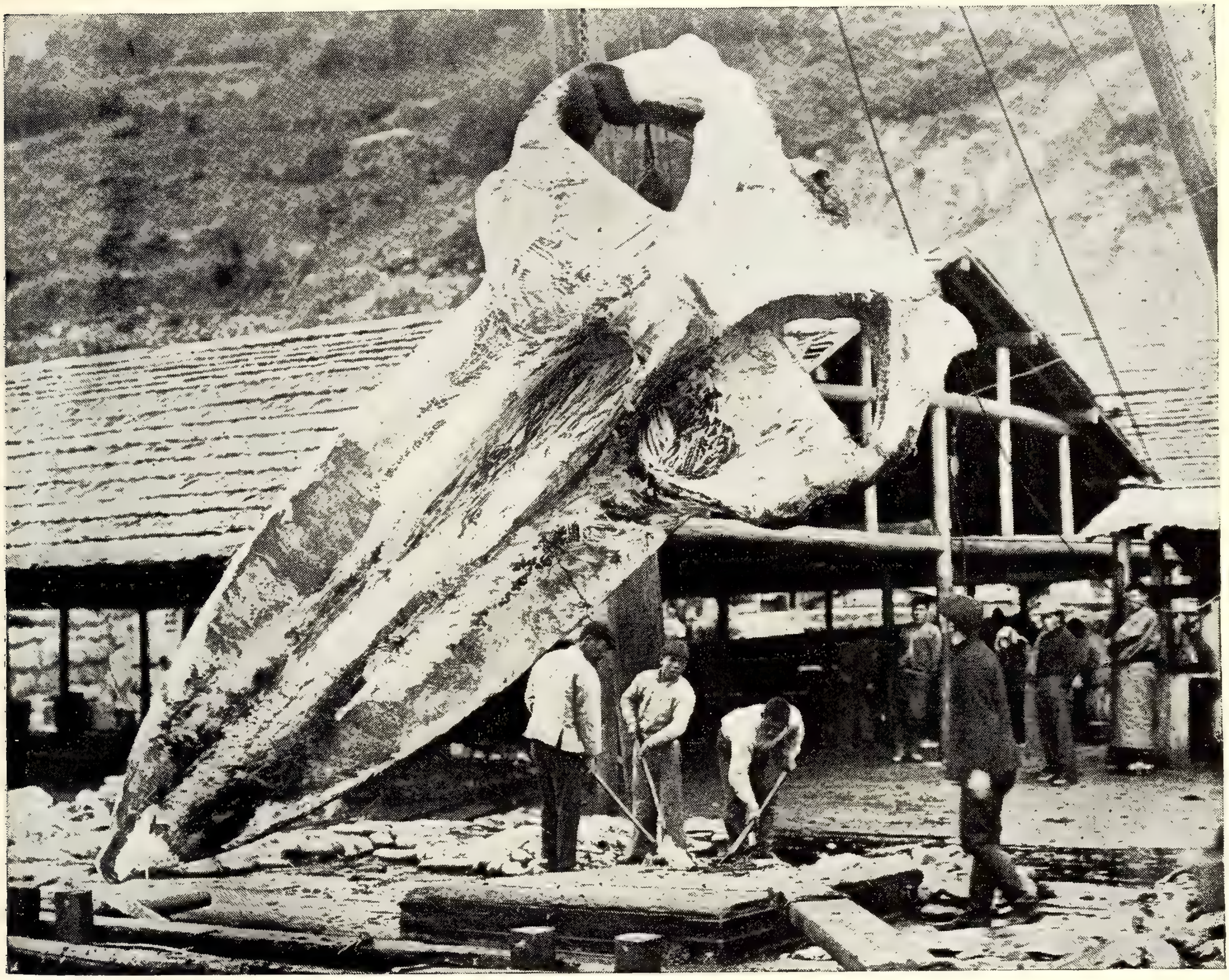
"The finback, closely related to the blue whale, has been called the 'greyhound of the sea,' for its long, slender body is built on the lines of a racing yacht and the animal can equal the speed of the fastest steamship" (see page 428).

Little is known about the breeding habits of whales, except that the young of whales are born alive, and are suckled and vigorously defended by the mother, as in the case of land mammals.



CROSS-SECTION OF THE HEAD OF A SPERM WHALE

This species of whale carries two rows of 20 or 25 heavy teeth in its lower jaw. The teeth may be observed in the left portion of this picture. The teeth assist in holding the giant squid and cuttlefish, on which the enormous animal feeds. This picture also shows very clearly the layer of blubber surrounding the flesh (see pages 414 and 439).



SKULL OF A BLUE WHALE SENT TO THE AMERICAN MUSEUM OF NATURAL HISTORY FROM JAPAN

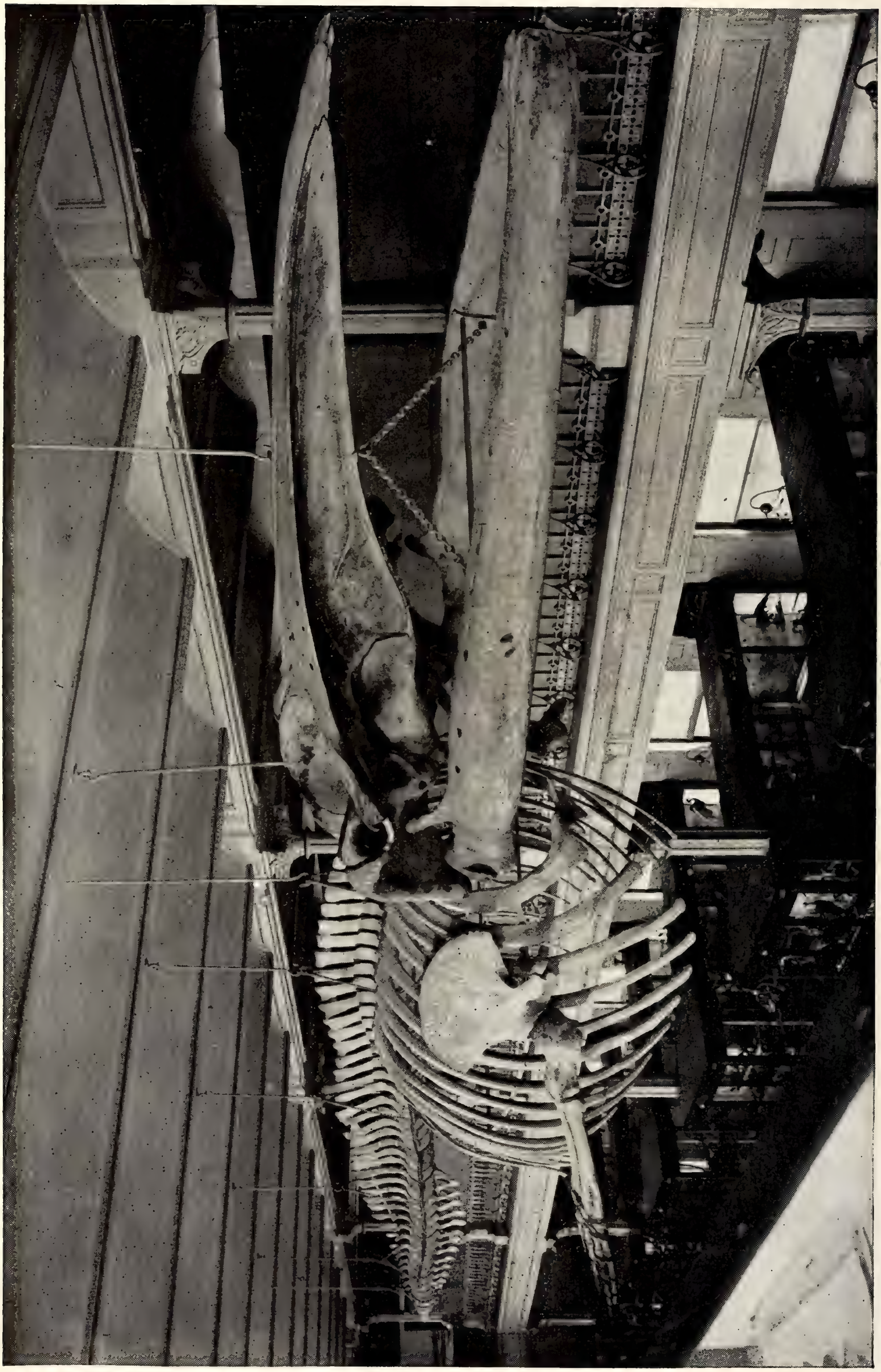
there is little doubt but that most large whales can remain under water a considerably longer time.

Both humpbacks and finbacks, when two or more individuals are together, will frequently swim side by side so closely as to almost touch each other, leaving the surface and reappearing again at exactly the same instant. Also a school, when separated by perhaps many hundred yards, will disappear as though at a given signal, double under water, and rise again a mile away, all blowing at the same time. How they communicate with each other—for it seems that they must do so—is a mystery for which I cannot even suggest an explanation.

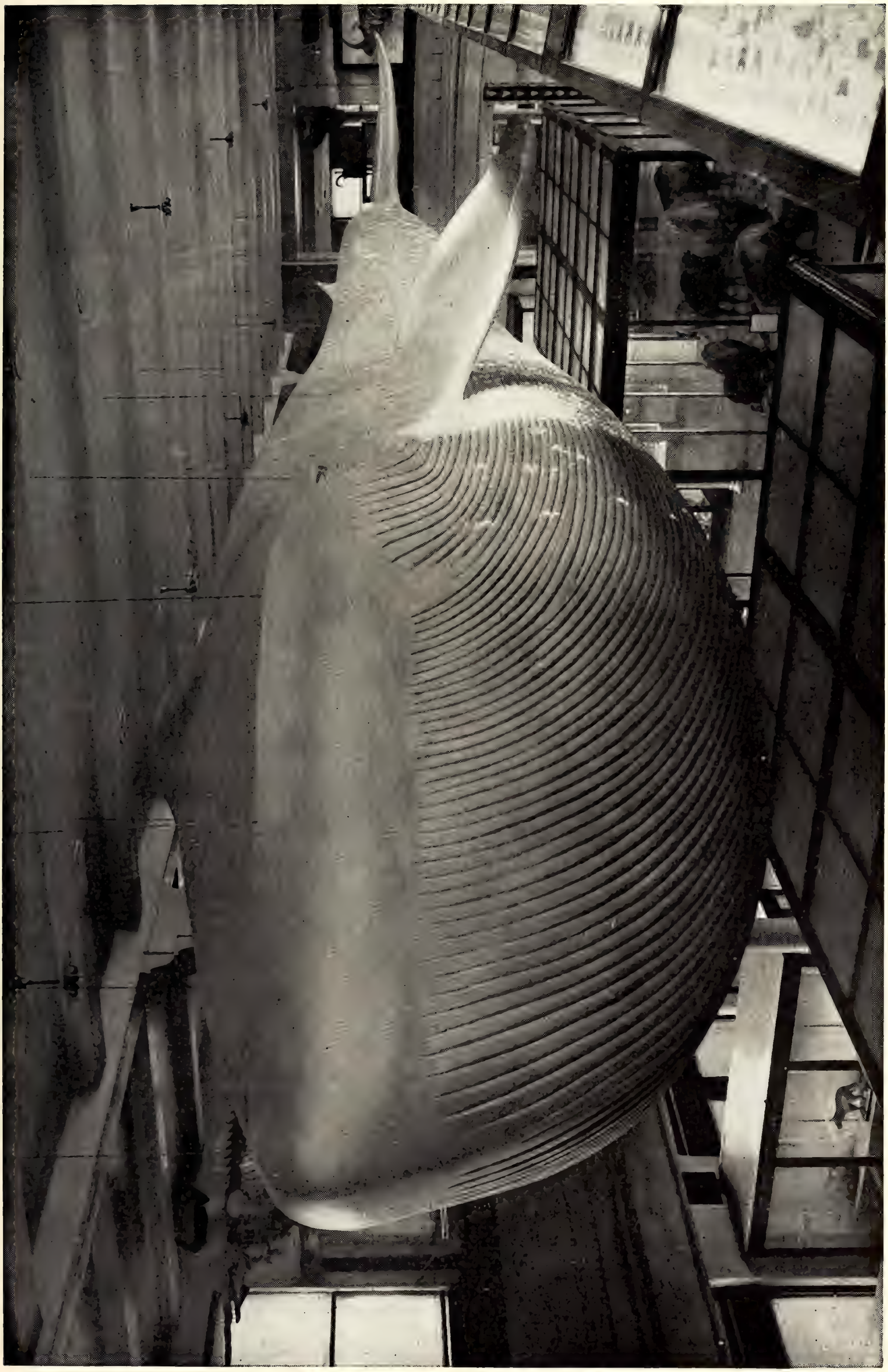
THE GIANT SPERM WHALE

No mammal which inhabits the sea is more extraordinary and grotesque in appearance than is the heavy-bodied, square-nosed sperm whale, and I suppose no mammal could furnish a more interesting study to the naturalist. At very few of the shore stations are sperms taken, but in the north of Japan, during August and September, they are killed in numbers (see pp. 434, 436, and 438).

Instead of having plates of baleen, this whale carries a row of 20 to 25 heavy teeth on each side of the lower jaw. These fit into sockets in the roof of the mouth and assist in holding the giant squid and cuttle-fish on which the enormous animal feeds. Since the squid



SKELETON OF FINBACK WHALE MOUNTED IN THE AMERICAN MUSEUM OF NATURAL HISTORY



BLUE OR SULPHUR-BOTTOM WHALE: LIFE-SIZE MODEL: LENGTH, 76 FEET

In the American Museum of Natural History; prepared under the direction of Roy C. Andrews and James L. Clark

WHALE MEAT READY TO BE SHIPPED TO THE MARKETS: JAPAN

In Japan hundreds of tons of whale meat are sold in the markets of all the large towns to people too poor to buy beef. The usual price is 7 or 8 cents per pound. One whale yields as much meat as a herd of 100 cattle (see page 425).

seldom gets far out of the warm currents, the sperm does not go into the cold water, but cruises about in the tropics and in the Gulf and Japan streams.

In the upper portion of the head the whale has an immense oil-tank in which the valuable "spermaceti" is found in a liquid condition and from which it may be dipped out with a bucket when an incision has been made. From a sperm whale 60 feet in length which was sent to the Museum from Japan, 20 barrels of spermaceti were taken out of the "case" and the surrounding fat. This oil congeals as soon as it is cooled by the air, but the natural heat of the body keeps it in a liquid condition until the case is opened.

The sperm whale is the animal which yields ambergris, the valuable substance used so extensively in the manufacture of our best perfumes. Ambergris is only found in "sick" whales; that is, its presence is not normal, but is caused by a pathological condition of the intestines. It has been found floating upon the water, and is also taken from the intestines themselves after the whale has died or has been killed. It is used as a vehicle for perfumes and not as an odor itself.

A LAND OF DROUGHT AND DESERT—LOWER CALIFORNIA

Two Thousand Miles on Horseback Through the Most Extraordinary Cacti Forests in the World

By E. W. Nelson

Of the U. S. Department of Agriculture

With Photographs by E. A. Goldman

LOWER CALIFORNIA is the long, narrow peninsula that projects about 800 miles southeasterly from the southern border of California. Its width varies from about 30 to over 100 miles, and its irregular coast-line, over 2,000 miles long, is bordered by numerous islands. Being mainly a mountainous, desert region, it is thinly peopled and presents many sharply contrasting conditions. Here low, sun-scorched plains, where death by thirst awaits the unwary traveler, lie close to the bases of towering granite peaks, belted with waving pine forests and capped in winter by gleaming snow.

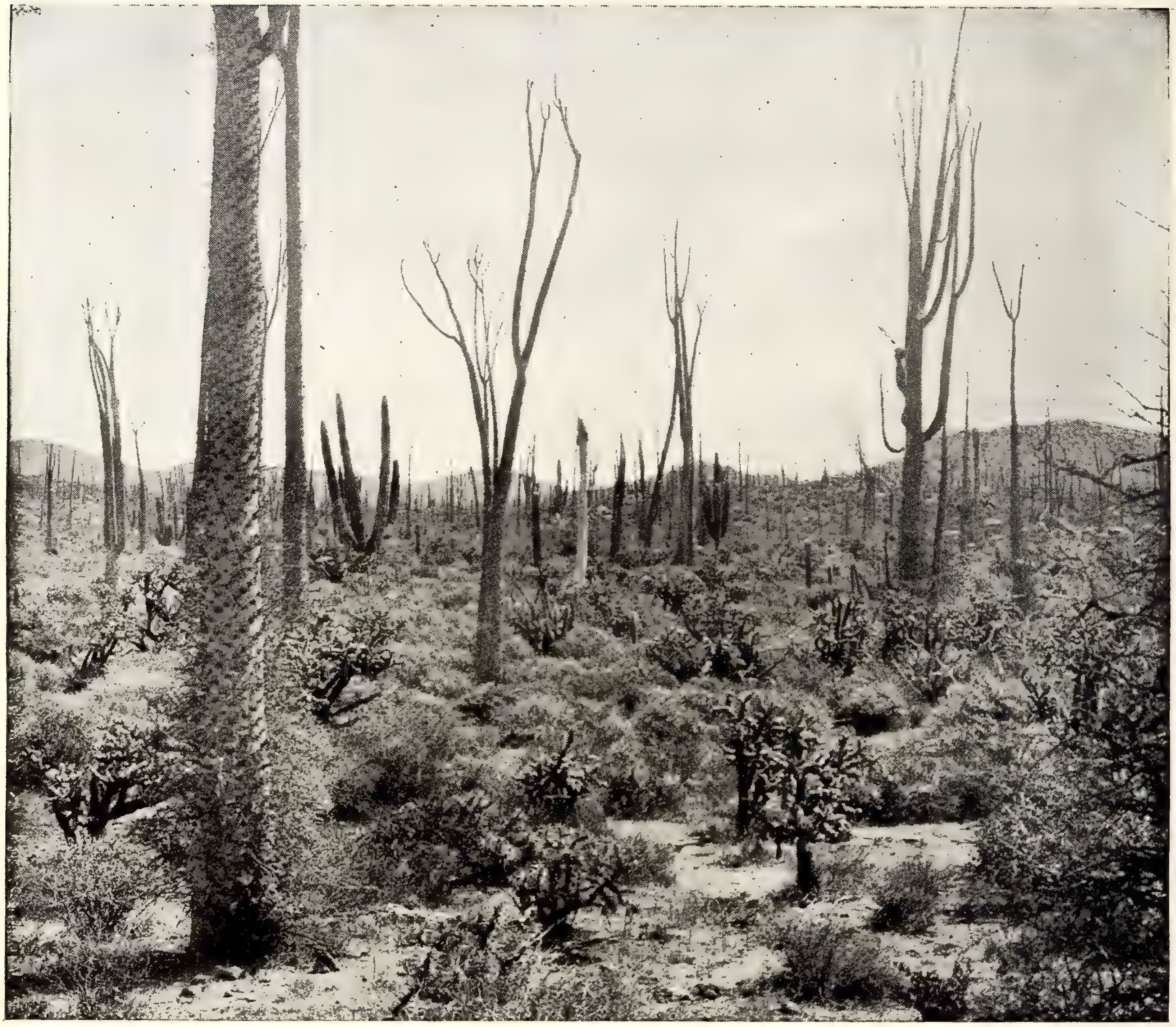
Vast desolate plateaus of ragged black lava embosom gem-like valleys, where verdure-bordered streams and the spreading fronds of date palms recall the mysterious hidden vales of the "Arabian Nights." Its western coast is bathed by cool waters and abundant fogs, while the eastern shore is laved by the waves of a warm inland sea, sparkling under almost continuous sunshine.

Although adjoining some of our best-known territory and with a recorded history which goes back almost four centuries and teems with varied events, the peninsula still remains one of the least-known parts of North America. The early chronicles tell of its discovery in 1533 by an expedition sent out by Cortés in search of a fabulously rich island said to have been inhabited by Amazons.

THE PATIENT WORK OF THE JESUITS

It has been estimated that at the time of its discovery the peninsula, including many of the bordering islands, was peopled by about 25,000 Indians. The inhabitants vigorously resented the intrusion of newcomers, and for more than a century efforts to establish military colonies in the new land resulted in disastrous failures. Then the occupation of Lower California was put in the hands of the Jesuits, and their missionaries were wonderfully successful. They explored all parts of the peninsula and established missions throughout most of its extent, at the same time introducing many of the crops and fruits of the old world.

In addition they established the three main trails, which extend practically the entire length of the peninsula and to this day serve as the regular routes of travel. One leads along each coast and the third down the mountainous interior. The coast trails are easier to travel, because less broken; but the middle one is most used, owing to its better grazing and more numerous water-holes. We followed this route most of the time, but at intervals changed back and forth to the others.



FOREST OF THE "CIRIO" (*Idria columnaris*), NEAR SAN FERNANDO

This tree is one of the strange desert plants peculiar to Lower California. It varies from 30 to 60 feet in height, and is covered by numberless short and extremely thorny branchlets with small leaves. The flowers are pale yellow and grow in tufts on the ends of numerous long, slender stems at the extreme tops of the trees. The bark is pale greenish yellow (see pages 449 and 461).

In the south we traversed long sections of trails which had been made passable by laboriously clearing away great quantities of broken lava, where otherwise the route would have been impracticable. These were bits of the "Camino Real," or Royal Highway, made centuries before by the Indians under direction of the early missionaries. These roads are all foot-trails, wagon roads only existing in detached stretches here and there. Two wagon roads cross the peninsula, one from Ensenada to San Felipe Bay, branching in the interior to Calexico on the California border, and another from La Paz to Todos Santos. Two others penetrate the northern part of the peninsula from the border, one down the top of the Laguna Hansen Mountains and the other along the coast from near San Diego to below San Quintin. Three or four of these roads penetrate the interior from landing places on the west coast, usually leading to some mining camp.

Today the Indians have vanished from all parts of their former territory, except a few in the extreme northern end of the peninsula. Some of the old mission churches are still in use, but most of the missions are represented by fragments of ruined walls and choked irrigating ditches.

The records of the dangers and obstacles met and overcome by such men as Padres Salvatierra, Kino, and Ugarte in their peaceable conquest of the peninsula excite one's deepest admiration. The work they accomplished and their resourcefulness and steadfast courage entitle them to a place in the front ranks of those stout-hearted pioneer explorers who first made known the wildest parts of America.

THE HIDING-PLACE OF FREEBOOTERS

During one period in its history the southern shores of the peninsula served as the lurking place of Sir Francis Drake and other freebooters lying in wait for the treasure-laden Spanish galleons on their annual voyages from Manila to Mexico.

Afterwards, during the first two-thirds of the last century, those shores were visited by numerous half-pirate smugglers and by fleets of whalers and sealers, drawn there by the swarming abundance of whales, fur seal, sea elephants, and sea otter. So ruthless was the pursuit of these animals that in a few decades they were on the verge of extermination, and the business ended, apparently forever.

The pearl fisheries of the Gulf coast were extremely productive at first and furnished the Spanish court with some of its richest jewels. Pearl-fishing still survives as a profitable industry, and is in the hands of two or three concessionaires with headquarters at La Paz (see also page 457).

THE UNITED STATES HAVE TWICE HELD POSSESSION OF LOWER CALIFORNIA

It may be unknown to many that the United States or its citizens have twice had complete possession of Lower California. During the Mexican War, in 1847, the forces of the United States occupied the principal points in the peninsula and declared it American territory, but relinquished it at the close of hostilities. In 1853-'54 it was again captured and a government temporarily organized by bands of American filibusters under Walker. This ill-advised venture lacked support and quickly came to a disastrous end.

During the last half century all parts of the peninsula have been visited, mainly by Americans, in search of mines and other natural resources, but little of the knowledge thus gained has become available to the public. Gold, silver, copper, iron, and other minerals and much fertile land have been found, but the scarcity of water, fuel, forage, and the difficulties of transportation have united with other causes to bring about many failures in the attempts to develop these resources.

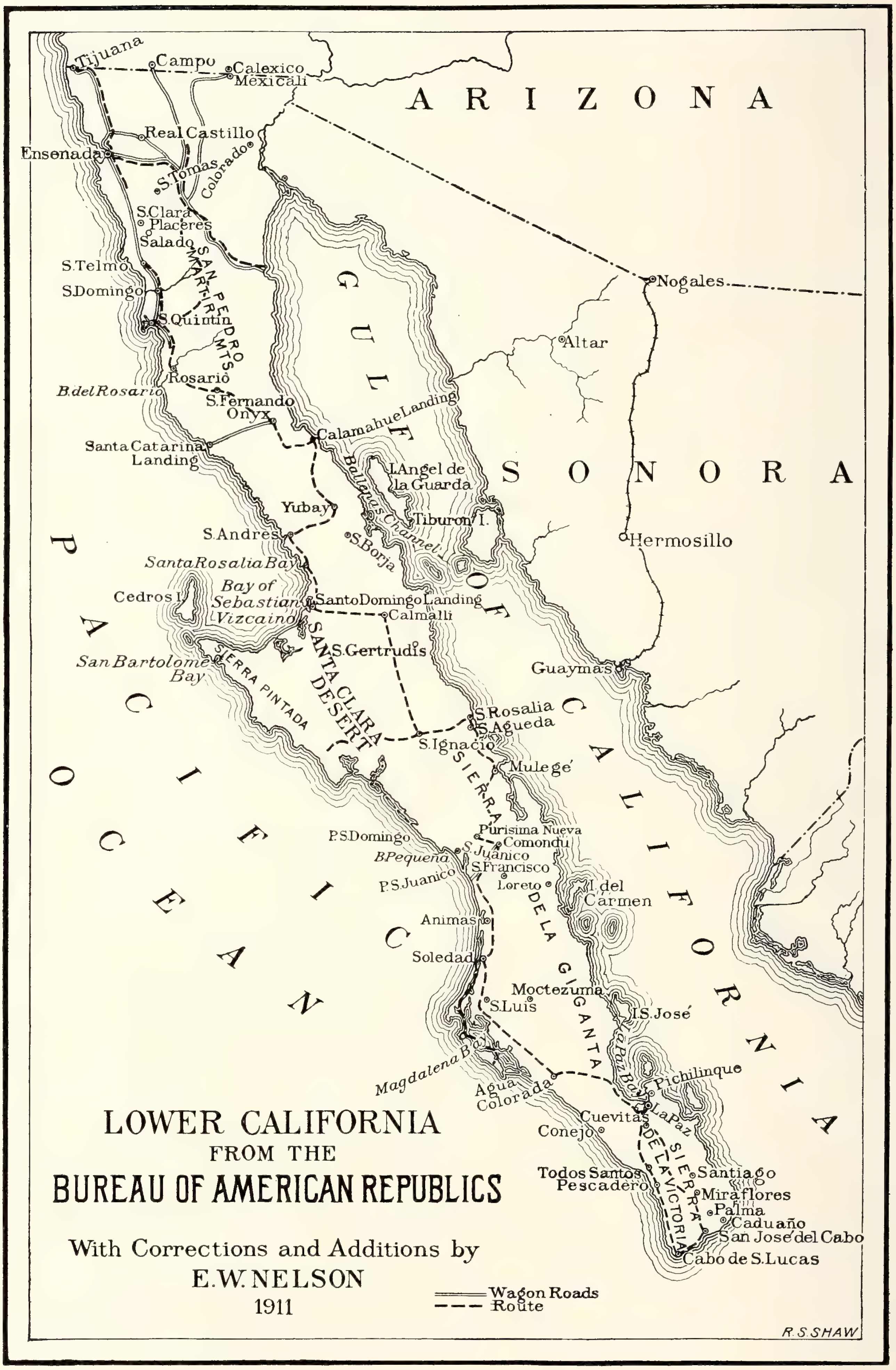
A few silver mines, notably at Triunfo, in the south, and Las Flores, on the Gulf coast, have been worked profitably. Onyx is mined and shipped to California, and enormous salt deposits exist on the shores of the Santa Clara Desert and on Carmen Island (see also page 465).

The most extensive and successful mining enterprise the peninsula has known is that of El Boleo Company, at Santa Rosalia, on the Gulf coast, where a French company has one of the largest producing copper mines in the world, which supports a town of about 8,000 people. Considerable prospecting for mines is still being done, mostly by Americans, and efforts are being made to develop mines at various points, always in the face of many serious obstacles.

Americans have made a number of attempts to establish agricultural enterprises and colonies; but, with the exception of the recent development of agricultural lands by use of water from the Colorado River, immediately south of the border, opposite the Imperial Valley, California, these efforts have been almost uniformly unsuccessful.

TWO THOUSAND MILES ON HORSEBACK IN THE DESERT

In connection with our work, a preliminary boat expedition was made by



OUTLINE MAP OF LOWER CALIFORNIA, SHOWING ROUTE OF AUTHOR, E. W. NELSON

Mr. Goldman with Dr. D. T. MacDougal, of the Carnegie Institution, to the delta of the Colorado in March and April, when the flood-plain of the Hardy River, at the base of the Cocopah Mountains, was covered with water.

In May we proceeded to Ensenada, a small port on the west coast of the peninsula, about 75 miles south of San Diego, to outfit for our long journey. This place is at the head of a small bay, with the steep slopes of the coast mountains rising a short distance inland. Some years ago Ensenada had a temporary "boom" while efforts were being made to establish an agricultural colony there. At the time of our visit the town was more deserted than usual, owing to the number of people who had gone to seek employment on the irrigation works of Imperial Valley. This town is the main port of the northern part of the peninsula as well as the capital of the northern district. Lower California has a territorial form of government, and, owing to its great length, is divided near the middle into a northern and a southern district, Ensenada and La Paz being the capitals of their respective districts.

The governor of the northern district, Colonel Celso Vega, received us courteously and did everything in his power to forward the object of our visit. After some delay we secured the services of two Mexicans, who claimed to know the trails and water-holes along our intended route, with four saddle-horses and four pack-mules. Many of our self-constituted advisers predicted a sad ending to our journey, comforting us with the assurance that we should have secured saddle-mules in place of horses, for the latter would never carry us half way across the desert. It is no doubt true that mules are better fitted for desert work, but our horses, with a single exception, made the entire journey.

During the next 10 months we traversed the entire length of the peninsula and crossed it eight times from shore to shore, traveling on horseback a distance of more than 2,000 miles, in addition to several boat trips to islands offshore.

THE COUNTRY IS MAINLY MOUNTAINOUS

Lower California is mainly mountainous, with irregular plains, mainly along the Pacific coast, and smaller plains and valleys here and there along the Gulf coast and in the more elevated interior. In climatic and other physical features the northern third of the peninsula is a continuation of extreme southern California, with local modifications. In the east the southern end of the Colorado Desert crosses the border and continues down the Gulf coast to San Felipe Bay, but is more broken by desert mountains than on the Californian side of the line. The part of the desert lying immediately south of the Californian border, with Mexicali as its chief town, is already being improved by irrigation from the Colorado, and will share with the adjacent Imperial Valley of California in extensive agricultural development from this source.

Along the Pacific side a low range of coast mountains rise from 1,000 to 4,000 feet a short distance inland and extend over 100 miles southerly from the border. Back of this range lie a series of narrow valleys, beyond which rises the main interior mountain range, forming the backbone of the peninsula. These mountains constitute a high, narrow range over 150 miles long extending southeasterly from the California border. The southern section of this range, forming the San Pedro Martir Mountains, rises from 6,000 to over 10,000 feet above the sea and has a rugged and broken crest with bench-like valleys.

These are the highest and most picturesque mountains in the peninsula. From their bold summits one has a superb view across the Colorado Desert, with its barren ranges far below appearing like the ridges on a relief map. To the northeast a distant silvery line marks the course of the Colorado, while to the east one's vision crosses the shining waters of the Gulf of California to mountain ranges in the far interior of Sonora. The San Pedro Martir range bears a striking resemblance, on a smaller scale, to the southern part of the Sierra Nevada in the Mount Whitney section.

This range is composed of pale gray granite, and has a gradual slope through series of foothills to the west and a precipitous escarpment 3,000 to 8,000 feet high fronting the desert on the east.

The only pine forest in Lower California occupies the top of these mountains and extends almost the entire length of the range. It forms a narrow belt of rather scrubby yellow pines, with many Murray pines and a few sugar pines and incense cedars on the San Pedro Martir Mountains. At present this timber is of little value, while the growth is so widely scattered and difficult of access that much of it will always remain of no economic value. From the southern end of San Pedro Martir Mountains the main mountains of the peninsula continue as a lower, broader, and much more broken chain, made up of detached ridges, spurs, and occasional isolated peaks. These mountains lie almost wholly in the eastern half of the peninsula and often form a precipitous shoreline, sometimes for long distances along the Gulf.

Lower scattered ranges and foothills sometimes border the Pacific coast, but coastal plains extend for hundreds of miles along that shore. From the northern border southerly to near La Paz the general elevated interior backbone is continuous, but at this point the mountains descend to a broad, low plain, which extends across the peninsula from shore to shore and isolates the mountains of the extreme southern end from those of the north.

The mountains from La Paz north to the middle of the peninsula are chiefly volcanic. On the Gulf side these volcanic ranges have an abrupt slope; on the westerly side they form great lava-covered, sloping plateaus, broken by crater cones and scored and gashed by huge ragged canyons from 1,000 to 3,000 feet deep. This volcanic region contains some of the wildest and most desolate scenery imaginable, in the midst of which are set oases which include the most beautiful inhabited places in the peninsula (see pages 456-459).

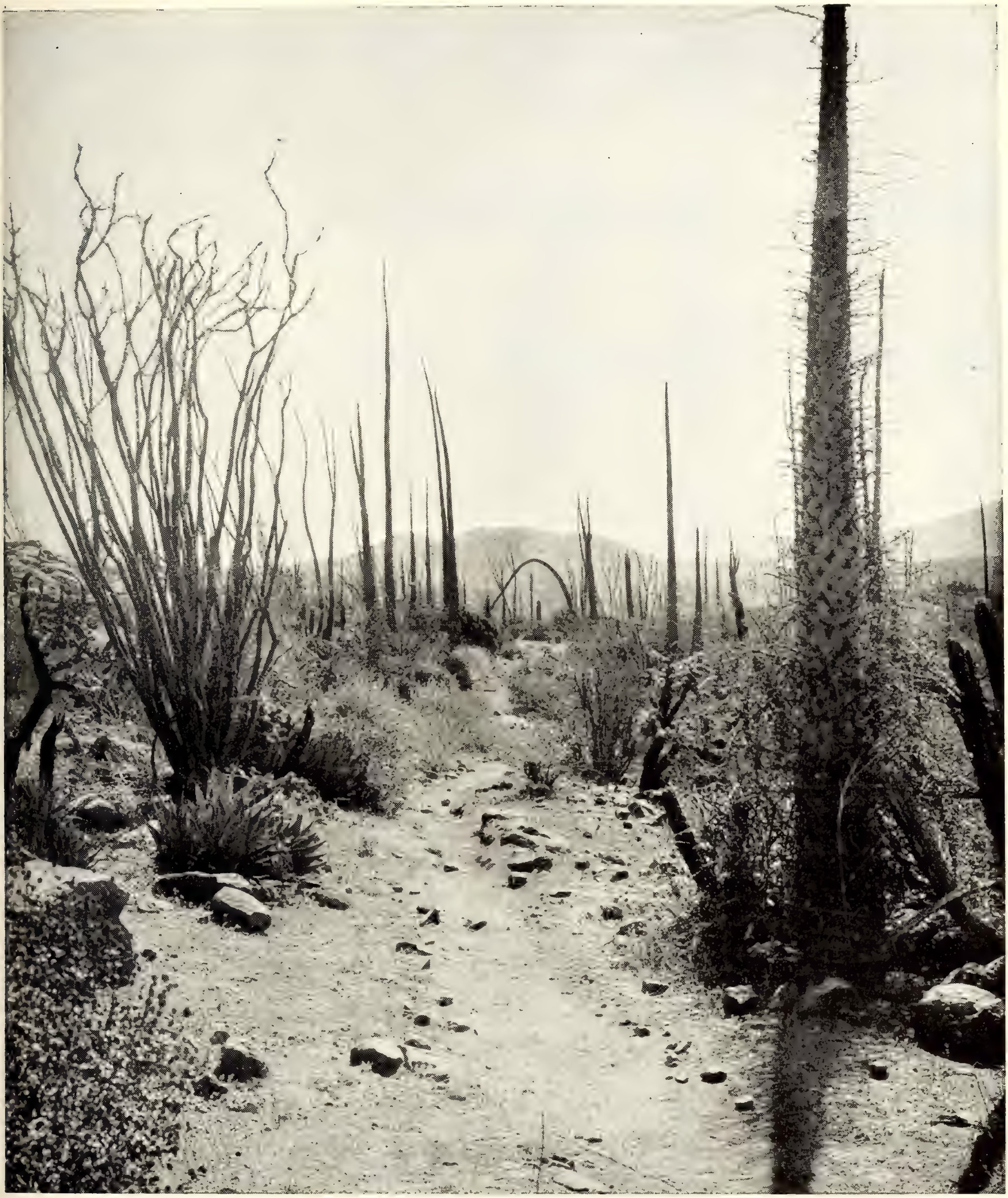
AN UNSUCCESSFUL COLONY

Three extended desert plains border the Pacific coast and are separated by low coastal mountains. The smallest and most northerly of these plains lies about San Quintin Bay and contains much fertile land and considerable water at moderate depth, although there is little on the surface. An unsuccessful attempt was made to colonize these lands on a large scale at the same time the effort already referred to was made at Ensenada. A large flour-mill was built at the head of San Quintin Bay, to grind the wheat the colonists were to grow, and a railroad started and built a few miles northward on its way to San Diego, where it was to carry the product of the mill! The little village of San Quintin, now consisting of a customs-house, a store, and a few dwelling-houses back from a small wharf, is the supply point for American prospectors and miners working among the barren mountains of this region.

From a few miles south of San Quintin to Santa Rosalia Bay the west coast is hilly. South of the last-named bay a great plain, the largest on the peninsula, comes in and extends for over 150 miles southward and from 40 to 50 miles inland. This is the Santa Clara Desert, which became known to many adventurous prospectors when the Santa Clara "dry placers" were discovered. These placers are on the seaward slope of the Santa Clara range, which borders the coast southeasterly from Cape San Eugenio, and their discovery led to a rush in 1900, but the scarcity of water on this inhospitable desert soon caused them to be abandoned. Santo Domingo Bay, on the northern border of this desert, is the landing place for supplies for the small mining camps of Calmalli and Campo Aleman, to which a good wagon road leads straight away into the interior.

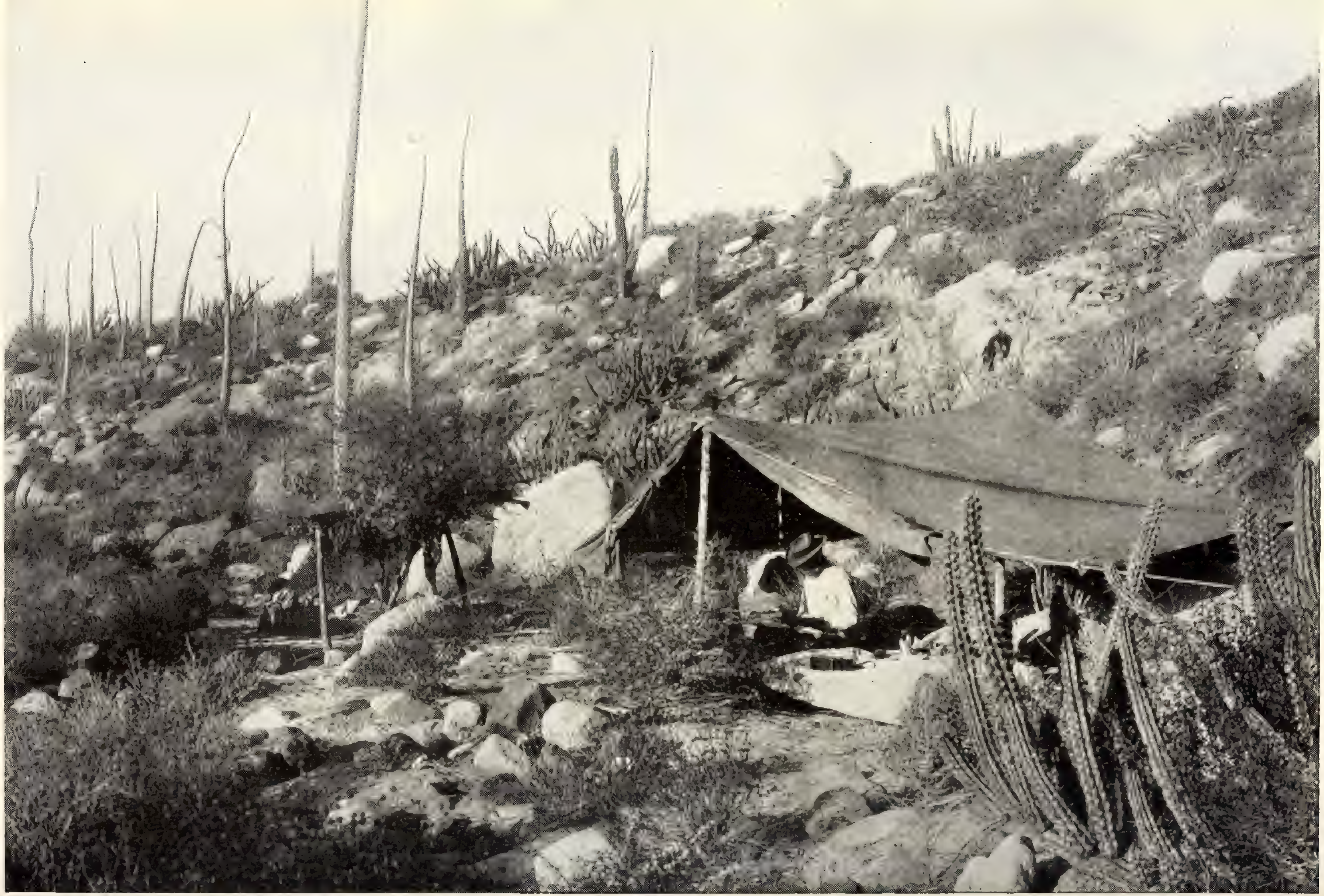
A NOTED BREEDING RESORT FOR WHALES

A little further south lies Scammon Lagoon, once a noted breeding resort for



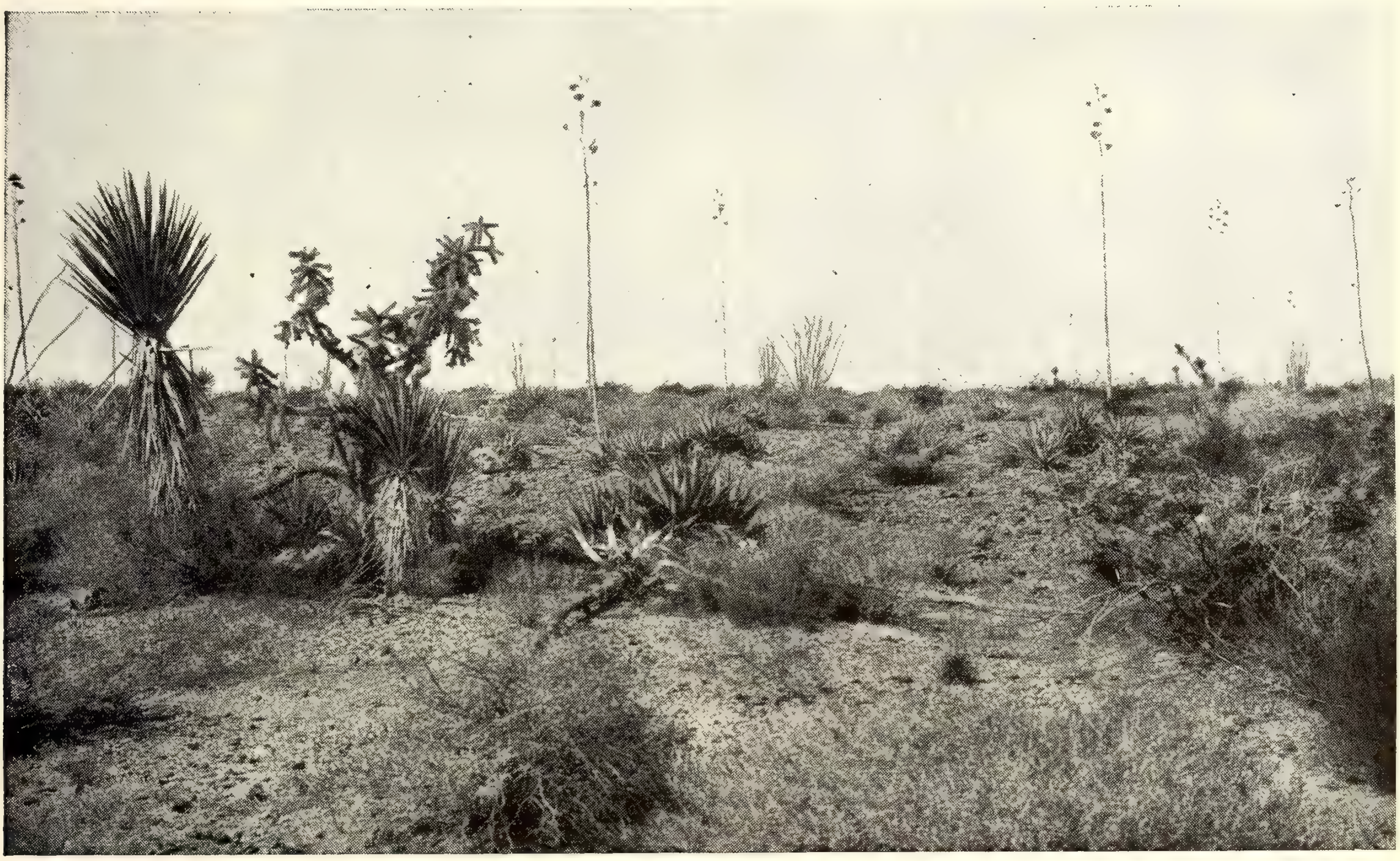
THE OLD MISSION TRAIL OF THE INTERIOR, LEADING THROUGH A FOREST OF DESERT PLANTS NEAR SAN FERNANDO

This trail, as were all the main trails in Lower California, was made by the Jesuits two or three centuries ago. The pole-like trees are the "cirio" (*Idria columnaris*); the many-branched shrub on the left is an "ocotilla" (*Fouquiera splendens*), which bears a brush-like mass of brilliant red flowers at the tips of the stalks. Small oval leaves grow along the stems.



A DESERT CAMP AT THE WATER-HOLE OF YUBAY

In the right foreground and elsewhere are many of the rough-stemmed cactus, *Lemaireocereus gummosus*, among the tall stems of the *Idria columnaris* and *Pachycereus pringlei*



PLAIN OF SAN AUGUSTIN

A sterile district, where small agaves are numerous, with a few yuccas, Fouquieras, and several species of small cactuses. The tall "poles" are the flower stalks of the *Agave shawii.*

whales, which animals suffered the usual fate of their kind and were killed or driven away by the whalers. All of this coast from Cape San Eugenio to Ensenada once abounded with whales, sea elephants, fur seal, and sea otter. One of the first missionaries who visited the coast near Cape San Eugenio speaks of the abundance of the sea otter and the ease with which his Indian companions killed them. These animals were still plentiful in 1809, when the American smuggling and trading ship *Dromio* visited Ensenada and bartered with the natives for 1,700 sea-otter skins.

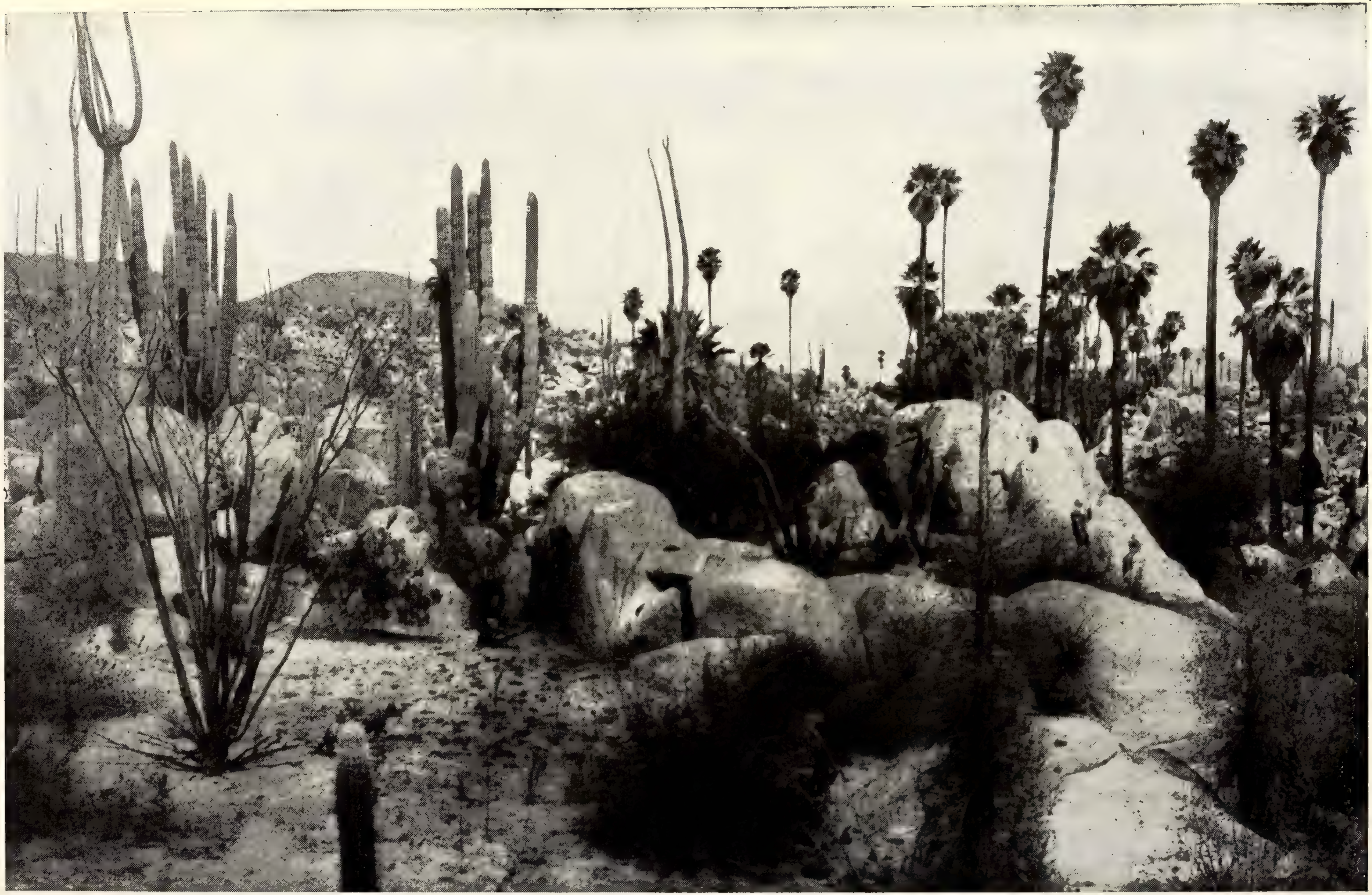
At the extreme head of Scammon Lagoon, in the Santa Clara Desert, is an enormous deposit of rock-salt, and a similar deposit exists on the southern end of this desert, near Ballenas Bay. Water is so scarce on this plain and there are so many rainless seasons that there is little prospect for any agricultural development (see pages 445 and 465).

South of the Santa Clara Desert the hills again border the coast for a few miles and then give way to the Magdalena Plains. This is another low coastal area which extends southeasterly along shore to Magdalena Bay and beyond, a distance of more than 200 miles. It varies from 10 to 30 miles in width and contains a large amount of fertile land, though surface water is extremely scanty. Water exists at moderate depth in many places, and one artesian well is flowing near the northern end of the plains.

THE AMERICAN ATTEMPTS TO COLONIZE MAGDALENA BAY UNSUCCESSFUL

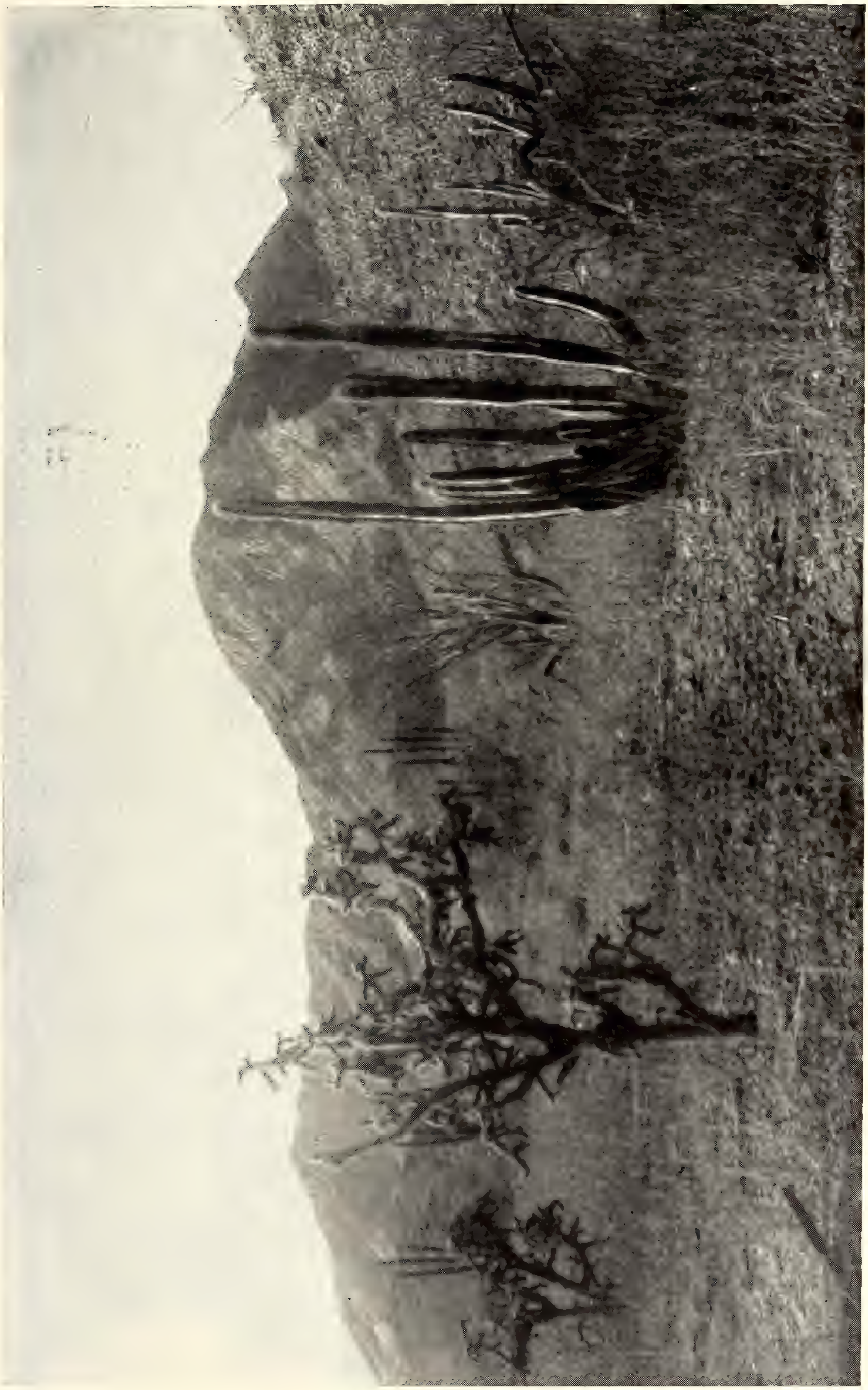
In 1870 an American colonization company, owning a large concession of land on Magdalena Plain, made an attempt to establish a colony on an open area known as the Llano de Yrais, bordering Magdalena Bay. In common with all other attempts to colonize the peninsula, this effort was a complete failure and was soon abandoned.

It was discovered, however, that the *orchilla,* a lichen resembling Spanish moss and growing abundantly on the



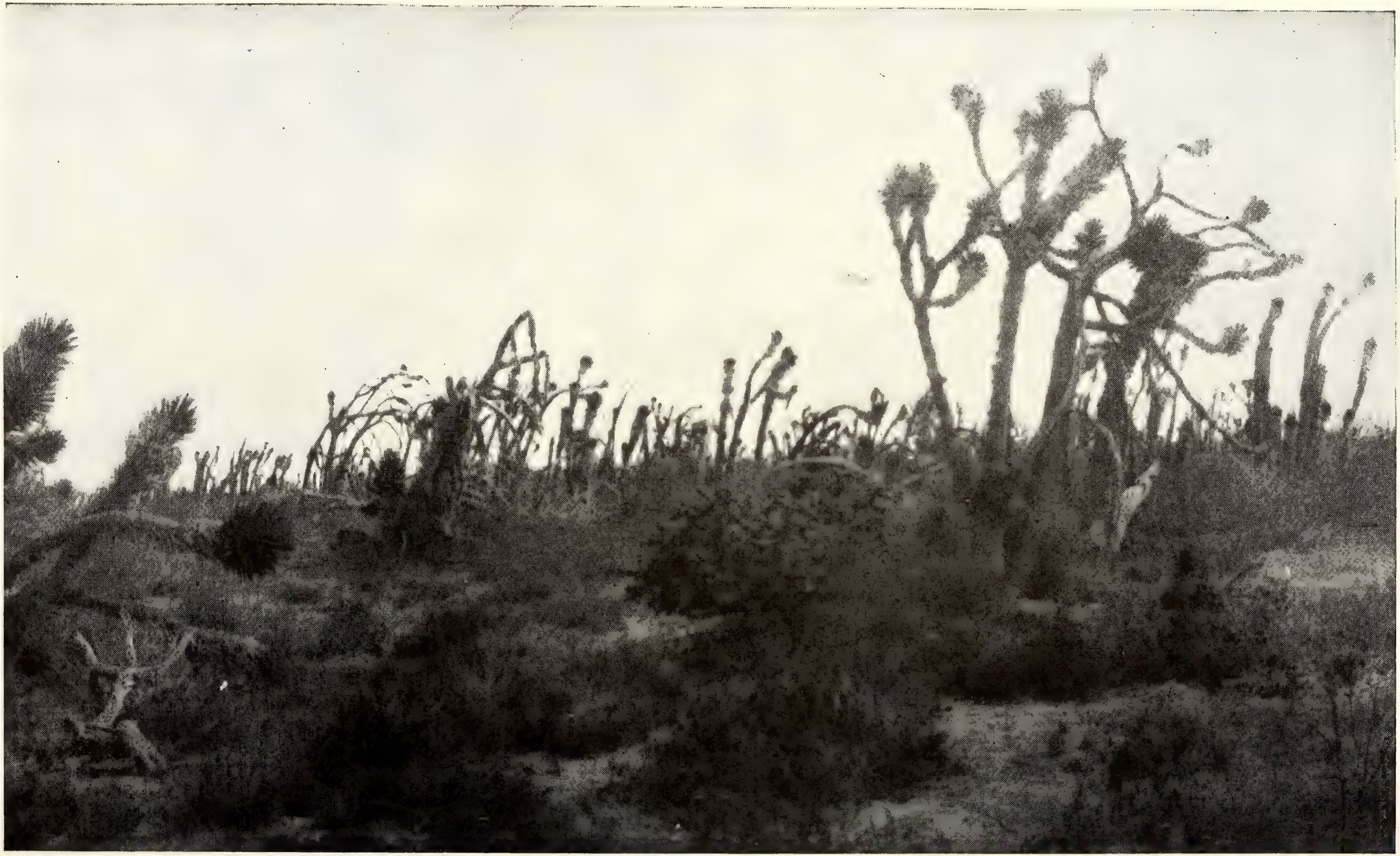
DESERT VEGETATION AT THE ARROYO DE CATAVIÑA SOUTHEASTERLY FROM SAN FERNANDO

For hundreds of miles down the elevated interior the country is covered with combinations of strange plant forms so fantastic in appearance that they might belong to some remote geological age, rather than to present time. In the left foreground is a *Fouquicra splendens,* behind which rise the pole-like *Idria columnaris* and the giant cactus *Pachycereus pringlei;* on the right are many beautiful palms (*Neowashingtonia*), marking the course of an underground flow of water (see page 463).



TYPES OF VEGETATION IN CALAMAHUE VALLEY, ON THE EXTREMELY HOT AND ARID GULF COAST

The peculiar tree on the left is a branching cactus, of a species of opuntia



A FOREST OF YUCCAS (*Yucca valida*)

This forest of many miles in extent covers the plain immediately inland from Santo Domingo landing, on the road to Calmalli. Owing to the strong and persistent northwest winds which prevail for months on this coast, the tops of many of these yuccas become permanently bent away from the course of the wind. The fixed position of these bent tops gives one the impression that a strong wind must be blowing, even when it is calm.

desert shrubs and small trees on this plain, was valuable for dyeing purposes. The firm of Flores, Hale & Co. secured a concession of a great tract of land, built warehouses on Magdalena Island, and established a flourishing industry in gathering this plant and shipping it to Europe. Eventually the discovery of chemically produced dyes destroyed the market for *orchilla,* and the possessions of the original company have passed into the hands of "The Chartered Company of Lower California," an American corporation, which owns a belt of land about 15 miles wide along the coast from 23° 30′ to 29° north latitude, covering an area of about 4,000,000 acres. This company has fine headquarters on Magdalena Island and many cattle on the neighboring plains, from which they supply fresh beef to vessels which visit the bay. Their headquarter cattle-ranch is at Soledad, 50 miles north of the bay. We were hospitably entertained at both places by the resident manager, Mr. W. J. Heney.

MAGDALENA BAY IS AN IDEAL HARBOR

Magdalena Bay is a beautiful landlocked harbor, with the narrow entrance guarded by the headlands of high, mountainous ridges extending back some distance on Magdalena and Margarita islands. The bay is about 15 miles across, with low, sandy shores on the eastern or mainland side and to the north and northwest. Magdalena village is on the western side of the bay, on the island of the same name, at the head of Man-o'-War Cove, a fine, sheltered nook formed by a curve in the mountainous shore, a few miles inside the entrance to the bay.

The absolute shelter within this bay and its delightful, sunny winter climate has for years made it a favorite winter practice ground for our Pacific fleet. On some flat land half a mile from the village on Magdalena Island are some low breastworks where the sailors formerly practiced shore-drill, but I was told this had been stopped, owing to protests from the Mexicans.

While we were at Magdalena the German training ship *Falke* came in and spent several days at both day and night practice. The activity of the night practice on one occasion gave us an uncomfortable half hour when we were crossing the bay in a small sloop. We were about half way across when the searchlights played over the water and firing began at target rafts, apparently too near our direction for comfort. However, we must have been seen, for the firing quickly ceased until we were well out of line. The officers and crew were a fine lot of men, and I was much interested to note the keen desire of the commander for information of every kind concerning the country we had traversed.

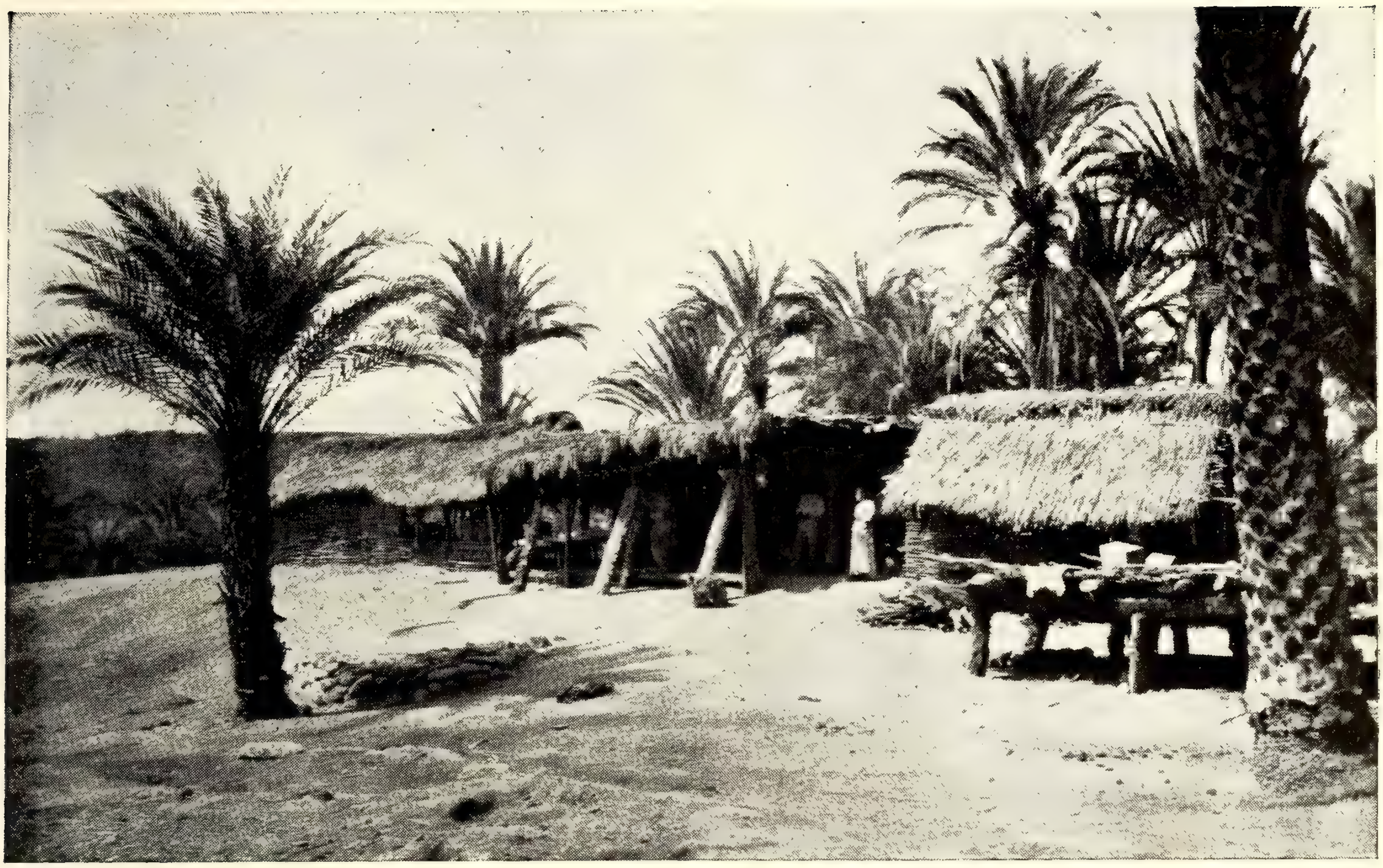
OUR PRESENT COALING STATION IN LOWER CALIFORNIA IS NOT COMPARABLE TO MAGDALENA BAY

The sailing route of steamers up and down the Pacific coast, whether to Mexican ports or to Panama, passes within sight of the entrance to Magdalena Bay, thus making it an ideal point for a coaling station. For many years the United States has had a naval coaling station in Lower California, located at Pichilinque, on the easterly side of La Paz Bay. This station is on the shore of an open bay in the Gulf of California and can be reached only by leaving the regular line of travel down the Pacific coast, rounding the southern end of the peninsula, and steaming up the Gulf a distance of over 200 miles off the route to Panama. An exchange of location of this station from its present site to Magdalena Bay would add greatly to its accessibility and usefulness. The only drawback to Magdalena Bay for this purpose is the scarcity of fresh water. It may be added that this place is about 1,100 miles from San Francisco, directly on the route to Panama.

At the extreme southern end of the peninsula the small town of San José del Cabo, containing a population of about 1,600, is located in a fertile little valley, where sugar-cane and other crops are grown. This is the largest agricultural town in the peninsula. Coasting steamers stop here regularly, lying off the open

CANYON OF SANTANA, NORTH OF SAN IGNACIO

One of the many wonderfully picturesque canyons which cut the great lava plateau in the southern half of the peninsula (see page 448)



NATIVE HOUSES AMONG THE DATE PALMS IN THE VALLEY AT SAN IGNACIO

Over 50,000 date-palm trees are growing in this beautiful oasis

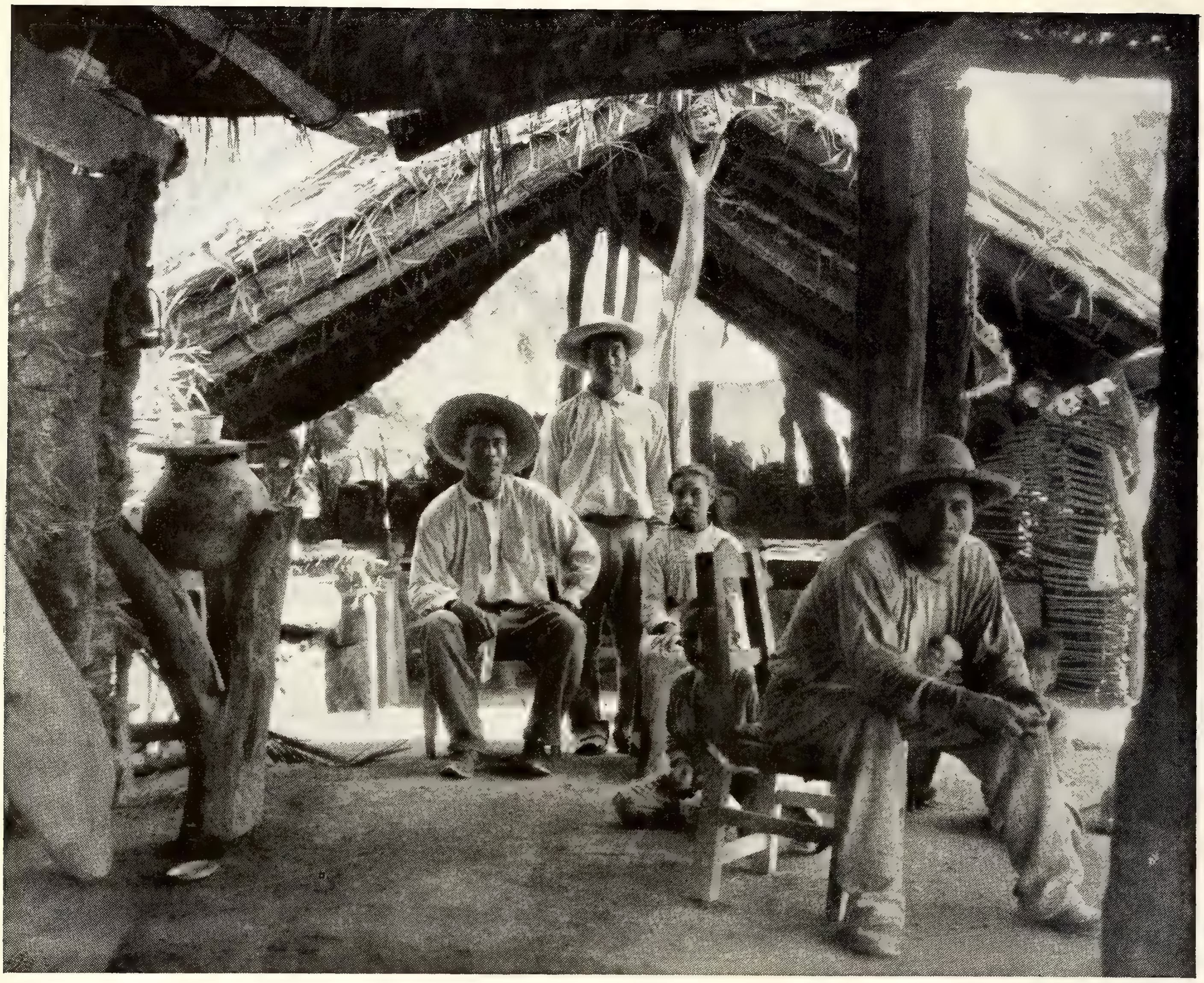
beach, to take on or leave passengers and freight.

LA PAZ IS AN ATTRACTIVE TOWN

La Paz, the oldest and most attractive town in Lower California, is at the head of La Paz Bay, in the Gulf. It is the capital of the southern district and the chief commercial port of the peninsula, containing nearly 6,000 people. The streets are well laid out and there are some excellent stores and many comfortable houses. The gardens are filled with palms and various tropical fruit trees, which give the place a strongly tropical appearance though set in the midst of an excessively arid desert plain. Water is abundant near the surface and is pumped for irrigation purposes. La Paz has always been the base of the pearl fisheries, which extend along the east coast of the peninsula and far down the west coast of the Mexican mainland. North of La Paz the only towns on the Gulf coast are the small agricultural settlements at Loreto and Mulege and the busy mining camp of Santa Rosalia, the largest town in Lower California.

A LAND OF LITTLE RAIN

The climate of Lower California in general is hot and arid, as evidenced by the existing desert conditions. In the northern part conditions are closely like those in the adjoining parts of southern California; in the middle they are more arid, but the extreme southern end, though arid tropical, has more regular summer rains. The rainfall on the peninsula comes from two sources. The winter rainy season along the north Pacific coast extends commonly over the northern parts of Lower California, and sometimes winter storms reach its extreme southern end. In summer the tropical rainy season extends across from the Mexican mainland to the southern end, and sporadic storms sometimes reach the northern border. The peninsula lies on the outer borders of the areas covered by both these rainy seasons and



INTERIOR OF THATCHED SHELTERS IN FRONT OF HOUSES IN DATE-PALM GROVES AT SAN IGNACIO

These are general living-rooms in hot weather. Note porous water-jar on left, in which drinking water is kept cool by evaporation from the outside of the jar

receives from them but scanty and uncertain precipitation.

Light frosts occur in winter on all the lowlands except a narrow belt along the immediate shore-line. At higher elevations, especially in the north, frosts are severe, and snow falls from one to six feet deep on the San Pedro Martir Mountains, where it sometimes remains for several months. The cool northwest winds and accompanying fogs on the west coast render the climate there much cooler and more agreeable in summer than that of the Gulf side, which is excessively hot and dry, temperatures commonly going far above 100° Fahrenheit in the shade.

The peninsula suffers long periods of drought, during which no rainfall sufficient to start vegetation occurs over large areas for periods of from three to five years. These dry periods may be succeeded by torrential rains, which sweep the country and roll great floods down the usually dry water-courses to the sea. During the long rainless periods the smaller desert herbage crumbles and is blown away, leaving the ground between the larger woody and fleshy plants as bare as though swept, and the larger plants become more or less dormant. With the heavy rains which follow, the bare earth is covered as by magic with an abundance of small flowering herbage and the larger plants burst forth into flower and foliage.

OLD MISSION CHURCH AT SAN IGNACIO, BUILT IN 1728

THERE ARE NO STREAMS OR RIVERS

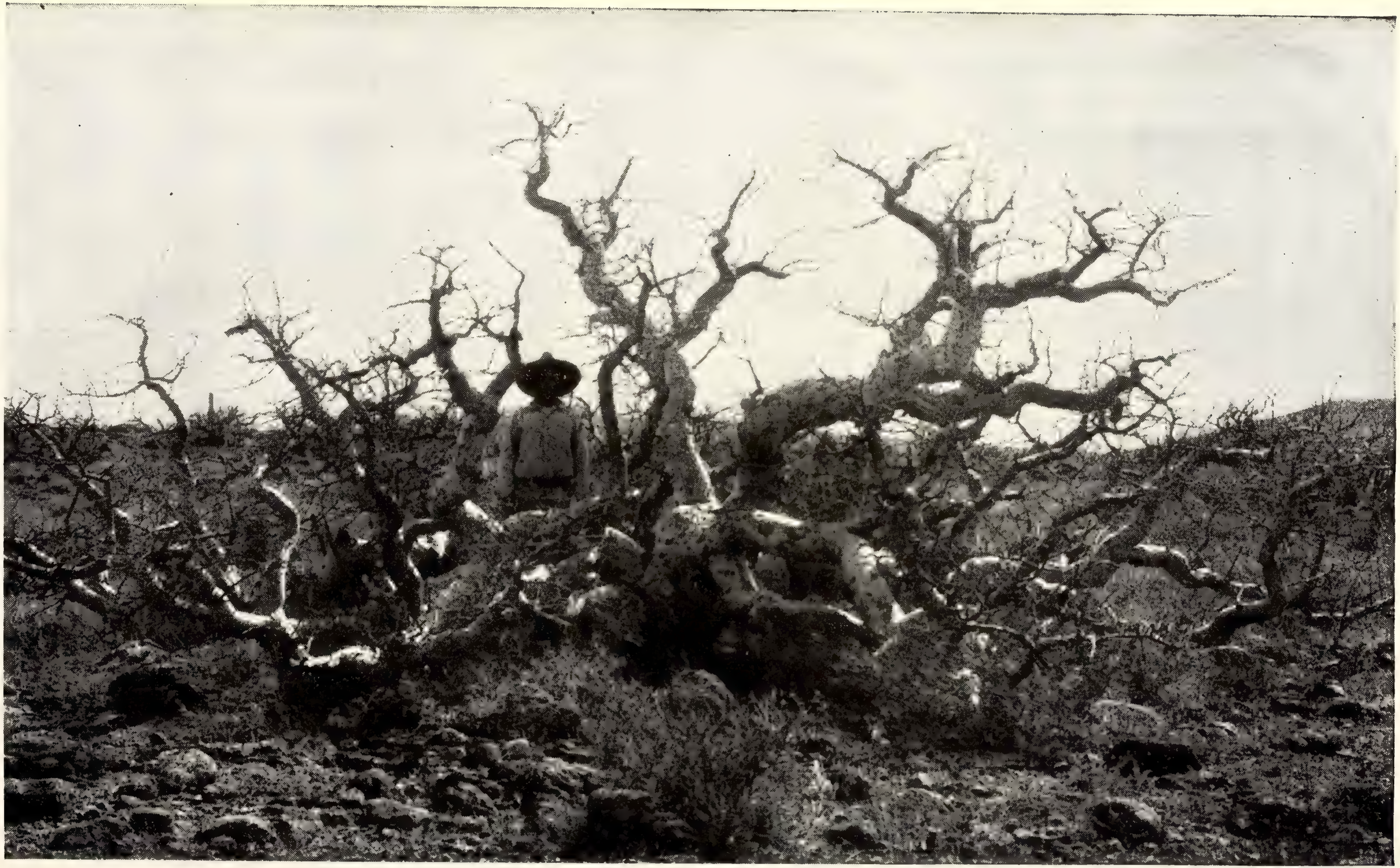
As a consequence of the lack of rain, surface water is very scarce and limited mainly to isolated water-holes in the rocks, or to springs from which small streams flow a short distance and then sink in the thirsty earth. In all its extended shore-line of more than 2,000 miles, only four or five small permanent streams reach the seashore, and all but one or two of these have their origin in springs rising a few miles inland, in the dry beds of canyons or other drainage channels.

The Rio Santo Domingo is the one living stream within the peninsula which flows on the surface from its source to the sea throughout the year. It rises high up on the west side of the San Pedro Martir Mountains and flows into the Pacific north of San Quintin.

This river—which is only a fair-sized creek—also has the distinction of being the only stream in Lower California which contains brook trout. In its course through a canyon in the foothills above San Antonio ranch we found many trout from 6 to 15 inches long. These proved to be a new species, related to the rainbow trout of California.

The next permanent stream, the Arroyo del Rosario, south of San Quintin, rises in the dry water-course and flows a few miles in the lower part of its channel to the sea. From this point southeasterly no flowing stream touches the shore until the mouth of the Arroyo de Todas Santos is reached, a distance of about 700 miles along the coast-line.

The eastern shore of the peninsula is even more poorly provided with running water, as the stream at Mulege is the only one until the mighty Colorado pours its flood into the head of the Gulf. In many places along both shores, however, good water may be obtained a few feet below the surface in flats or in the bot-



THE ELEPHANT WOOD (*Veatchia discolor*) IS ONE OF THE REMARKABLE TYPES OF DESERT VEGETATION KNOWN ONLY FROM LOWER CALIFORNIA (SEE PAGE 461)

It is a tree with a trunk one or two feet in diameter at the base, and six or seven feet high, with twisted and contorted branches tapering abruptly, and covered with a smooth, thick, spongy bark, which gives it a bloated, dropsical appearance. It has small compound leaves, which are shed annually. Before the leaves grow again the ends of the bare twigs are covered with a multitude of beautiful red flowers, toms of some of the numerous dry drainage channels leading down from the interior. Many small streams flow varying distances, up to 10 or 15 miles, in the bottoms of canyons in the high interior and then sink in the bottom of the washes. Some of them are large enough to irrigate hundreds of acres of land and support little isolated communities, as those in San Ignacio, La Purisima, or Comondu valleys. Owing to the cooler temperatures and more regular rainfall on the high mountains, there is a considerable area of pine forest in the north and a small area of scrubby oaks and pines in the extreme south.

THE MOST EXTRAORDINARY FLORA IN THE WORLD

The isolation of the desert lowlands of Lower California, combined with alternations of long-continued droughts and heavy rains, has resulted in the development of the richest and most extraordinary desert flora in the world, of which the accompanying photographs give an imperfect idea. For days our trail led through a wild profusion of gnarled and thorny growths made up of many species. At other times the growth was thinly scattered and other species came in, or a forest made up almost entirely of agaves or yuccas extended for miles, to be succeeded by other combinations.

Although familiar with the varied types of plant life, from the stunted growth of Arctic tundras to the exuberant foliage of the humid tropics, I have never seen such a fantastic riot of extraordinary forms as that afforded by the flora of Lower California. The combinations of species were often wonderfully picturesque and gave the landscape an individuality unlike anything to be found elsewhere. Many of these strange scenes seemed fit abiding places for the animal life of an earlier age rather than the familiar species of today. The middle section of the peninsula in particular appeared to be common ground for an extraordinary abundance of strange desert types of vegetation.

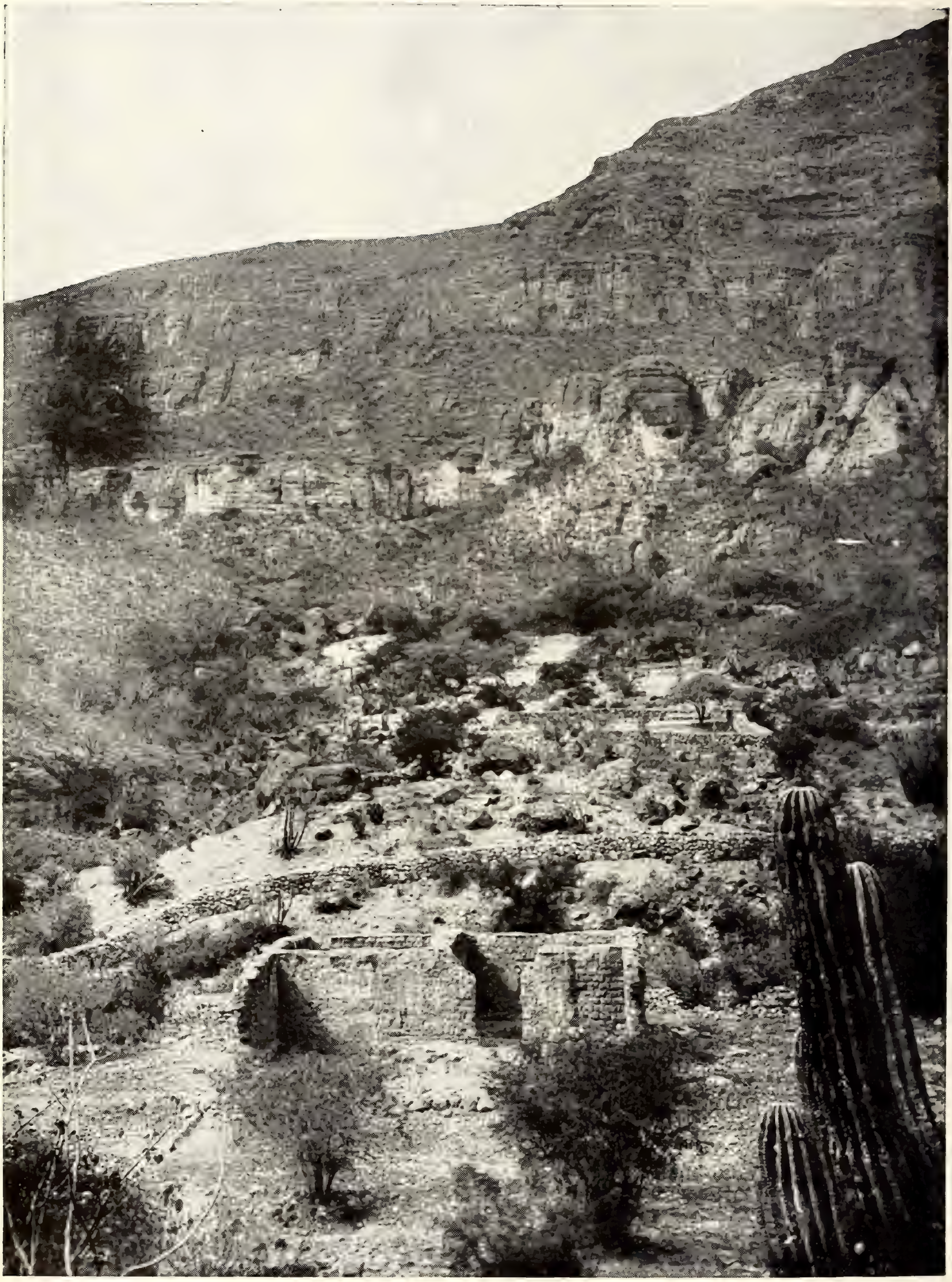
The cirio (*Idria columnaris*) is peculiar to this region and one of the most abundant and unusual of them all. It has a tall, tapering trunk 20 to 50 feet high, with pale yellowish bark, many extremely thorny branchlets along its entire length, and tufts of small yellowish flowers on the end of long, slender stalks at the extreme tip. Thin forests of these pole-like trees cover hundreds of miles of the interior (see pictures, pp. 444-9).

Cactuses of many kinds abounded, varying from giants standing with massive fluted trunks 50 to 60 feet tall to little straggling-stemmed species too weak to hold themselves upright. The fruit of many of these cactuses are edible and much sought for by birds and mammals. They were once one of the main crops of the Indians who lived in this arid region. The cactus forests often form impenetrable thorny jungles through which it was impossible to pass and which caused long detours when we left the trails.

THE CREEPING DEVIL CACTUS

After months among these thorny plants we supposed we had seen them in all their eccentric variations of form. One morning, however, while crossing the Llano de Yrais, in front of Magdalena Bay, I rode out from a dense growth of bushes into an open area and pulled up my horse in amazement at sight of the most extraordinary of them all. Before me was a great bed of the creeping devil cactus, which appeared like a swarm of gigantic caterpillars creeping in all directions. These plants actually travel away from the common center of the group, and I saw many single sections 20 to 30 yards away from the others. The part of the stem resting on the ground sends down rootlets and the older stems die in the rear at about the same rate as they grow in front, so they slowly move away from the colony across the flats where they live (see picture, page 466).

Another most remarkable plant is the elephant wood (*Veatchia discolor*), which, like the cirio, is confined to the



GUAJÁDEMI, AN ABANDONED RANCH NORTHERLY FROM LA LURISIMA

Note the extensive stone walls. Americans have made a number of attempts to establish agricultural enterprises and colonies; but, with the exception of the recent development of agricultural lands by use of water from the Colorado River, immediately south of the border, opposite the Imperial Valley, California, these efforts have been almost uniformly unsuccessful.

WATER-HOLE AT SAN ANGEL, ON THE EASTERN BORDER OF THE SANTA CLARA DESERT, 20 MILES WESTERLY FROM SAN IGNACIO

"I have come repeatedly to solitary water-holes, in the hottest weather, a long march from any other water, and found the loose earth about their borders undisturbed by tracks except those of birds, while within a few rods were tracks where wandering deer and rabbits had fed day after day with absolute indifference to the proximity of water. A large number of the smaller kinds of desert mammals, rats, rabbits, etc., never drink water. Apparently they never know thirst or the delight of quenching it" (see page 467).

middle parts of the peninsula, but occurs also on Cedros Island. It is a curious dropsical-appearing tree, from three to six feet high, with a trunk measuring a foot or two in diameter at the base and sending out thick, wide-spreading, contorted branches. Both trunk and branches are covered with a smooth-skinned bark lying in thick folds and curves, as though much swollen (see picture, page 460).

Here and there we saw combinations of plant forms so beautiful and strange as to suggest the flora of a past geologic age. This was specially notable in the Arroyo de Catavifia, a broad, dry wash of white sand winding through a shallow valley in a granite plain. Along the bottom near the wash were little groups of exquisitely graceful palms, their beauty heightened by the formal stiffness of their neighbors, the tall cirios, cactuses, and Fouquieras (see picture, page 452).

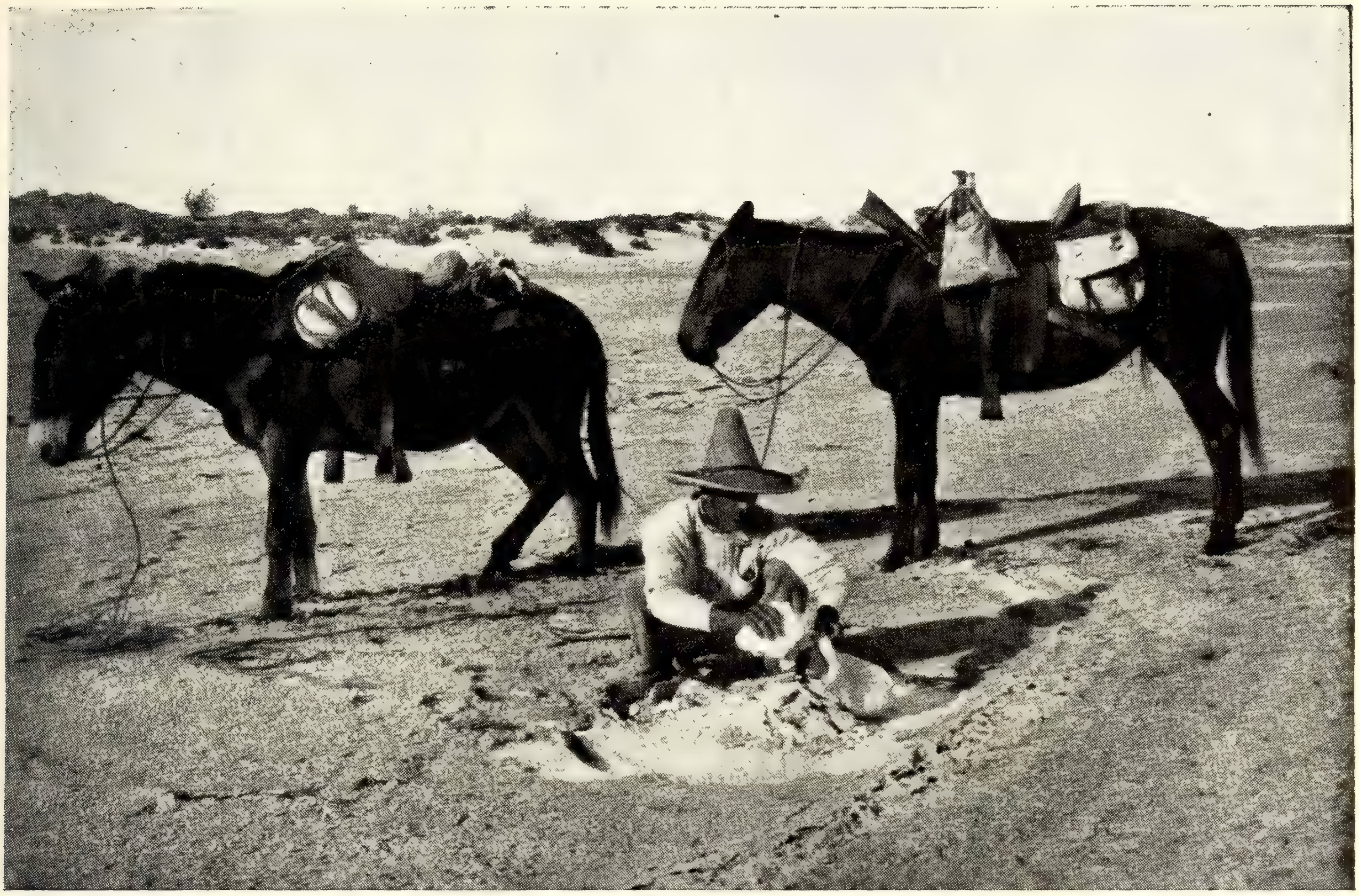
For hundreds of miles our route lay through these curious forests, and we found them most impressive when we were obliged to make long night marches to reach distant water-holes. For hours we rode silently in the brilliant moonlight through an unbroken succession of grotesque forms, half revealed by the uncertain light, until we seemed to be traveling in the unreal world of some fantastic imagination. On these occasions we traveled until the moon went down and left us in the black darkness

THE BEST HARBOR ON THE PACIFIC COAST SOUTH OF CALIFORNIA: MAN-O'-WAR COVE, MAGDALENA BAY (SEE PAGE 455)

With the village of Magdalena in the foreground and Margarita Island showing dimly in the distance. The entrance to Magdalena Bay is behind the southerly end of Magdalena Island, shown in this view, and in front of Margarita Island.

FLOODED PLAIN BORDERING MAGDALENA BAY, IN DECEMBER

The desert vegetation standing in the water made a strange and fantastic landscape



GATHERING ROCK-SALT FROM THE GREAT SALT BED ON THE SANTA CLARA DESERT, WEST OF SAN IGNACIO (SEE PAGE 445)

Enormous salt deposits exist on this desert and elsewhere in Lower California

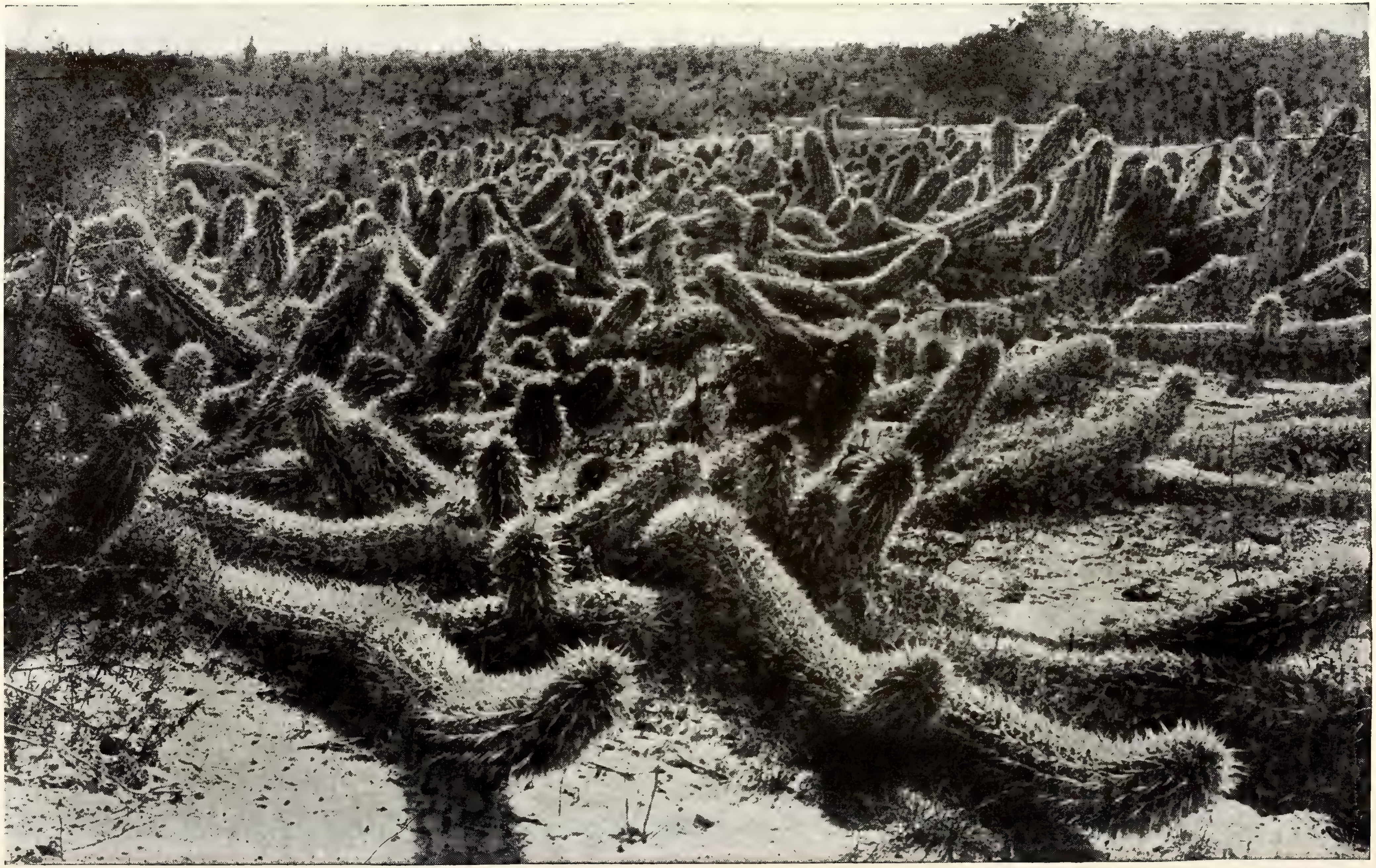
that followed to make camp as we could. Our camp men then gave us the benefit of their desert craft by setting fire to a dense group of half-dry yuccas, which almost at once set up a splendid torch-like red flame 8 or 10 feet high, brilliantly illuminating a broad circle for about half an hour, thus giving us ample time to unload the mules and arrange camp. Yuccas are fired in this way, also, to bring together members of a party when separated at night.

HONEY-BEES IN THE DESERT

During our stay in the pine-forested highlands of the San Pedro Martir Mountains we were interested to find swarms of wild honey-bees rather common in hollow trees up at least to an altitude of 8,000 feet. These were the descendants of swarms escaped from the bee-farms of southern California. Later, when we were on the coast plain at San Quintin, we found them living in small deserted cabins, their combs hanging free from the under side of the roof. They had also penetrated some of the most arid desert sections along the Gulf coast more than 200 miles south of the border.

In September, at the time of our visit to Dick Daggett's camp, at the mouth of Calamahue wash, scores of wild bees were buzzing about a canvas water-cooler hung in an open shed, thirstily sucking the moisture and then flying away over the sun-baked, cactus-grown hills. Daggett said his men lined the bees from this water, and then, by using burning beeswax and honey for bait, were able to find many nests in the rocks or in hollow stems of the cirio, and thus kept him well supplied with honey.

The recently made well here was the only available water supply for a long distance, but bees appeared very soon after the well was dug. Daggett informed us that some of the nests were found several miles from camp, thus in-



CREEPING DEVIL CACTUS (*Cereus eruca*) (SEE PAGE 461)

This is a species peculiar to Lower California. It grows in patches, covering the ground with its long, sinuous, reclining stems, which, with their raised heads, have the appearance of a great band of enormous spiny caterpillars creeping away. It is known only from a small district near Magdalena Bay.

dicating an extraordinarily long flight for these bees, which are unable to exist where they cannot get water.

MANY OF THE ANIMALS NEVER DRINK WATER

The bird and mammal life of all Lower California is closely related to that of southern California. Only a few species of birds and a single land mammal, all in the extreme southern end of the peninsula, appear to have originated on the Mexican mainland. All the others are evidently derived from well-known species of southern California, though they have been isolated long enough to develop numerous geographic forms. This is in strong contrast to the great differences shown by the flora, in which are numerous strongly marked species peculiar to this region.

As in similar arid areas of the extreme southwestern United States, the plains of Lower California ordinarily abound with small desert mammals, such as rabbits, pocket mice, kangaroo rats, and others. During long-continued dry periods vast numbers of these small mammals perish of starvation, owing to the failure of the necessary crops of succulent and seed-bearing herbage; but after two or three years of renewed rainfall and abundant plant life the desert again swarms with countless numbers of these small folk.

A large number of the smaller kinds of desert mammals never drink water. They live and thrive on dry seeds and scraps of vegetation in places where the heat and aridity are excessive without ever touching their lips to water, and it has even been found impossible to teach some of them to take water in captivity. Apparently they never know thirst or the delight of quenching it.

Large desert mammals, such as rabbits and deer, also obtain sufficient moisture by eating the succulent parts of certain plants they know how to find.

CUNNING FOXES

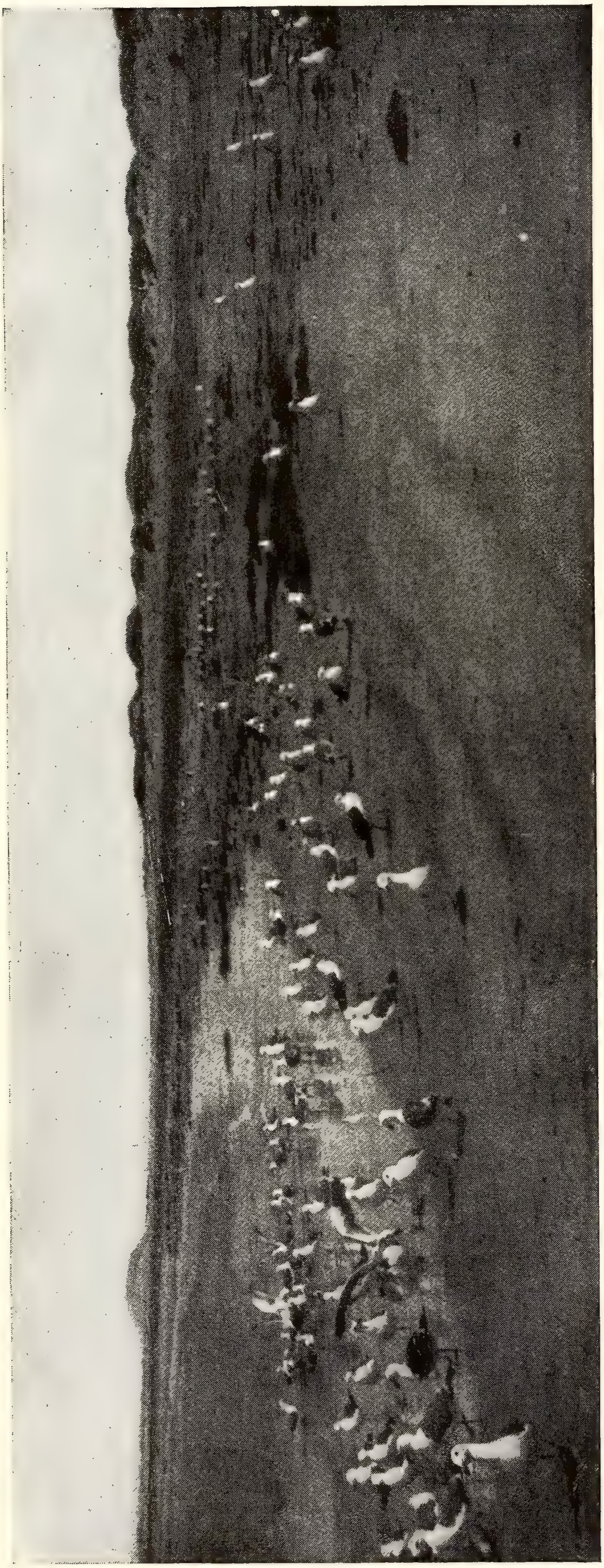
I have come repeatedly to solitary water-holes, in the hottest weather, a long march from any other water, and found the loose earth about their borders undisturbed by tracks except those of birds, while within a few rods were tracks where wandering deer and rabbits had fed day after day with absolute indifference to the proximity of water. The ability to do without water on the desert appears to be peculiar to rodents and other herbivorous mammals, since we found no signs of carnivorous species far from accessible water.

Small desert foxes, with large ears and bodies not much larger than that of a cat, occur on the larger plains throughout the peninsula. They live in burrows and when surprised away from home by day are very cunning in concealing themselves. As danger approaches they skulk to the nearest bush, tuft of grass, or other little object breaking the surface and sink down flat on the ground beside it, and although they may be in plain view, they are almost certain to escape notice unless seen before they reach shelter. When concealment becomes impossible they are up and off like a flash, and so swift and graceful are their movements that they appear to float across the plain like a yellowish gray streak. On the Magdalena plains the cowboys ride down and lasso coyotes for sport; but when I suggested their trying it on one of these foxes, they laughed and replied that they might as well try to catch the wind.

Antelope, mountain sheep, mule-deer, and mountain lions are the only large game animals on the peninsula. Antelope formerly occupied all the plains, but are now reduced to a small number in a few localities, and there appears to be little hope of saving them from early extermination. Deer are still numerous in many localities and with the mountain lion will outlast other large game in that region.

BEAUTIFUL MOUNTAIN SHEEP

The first mountain sheep discovered in America were those recorded in the early writings of the Spanish missionaries from Lower California. There are numerous species of mountain sheep in



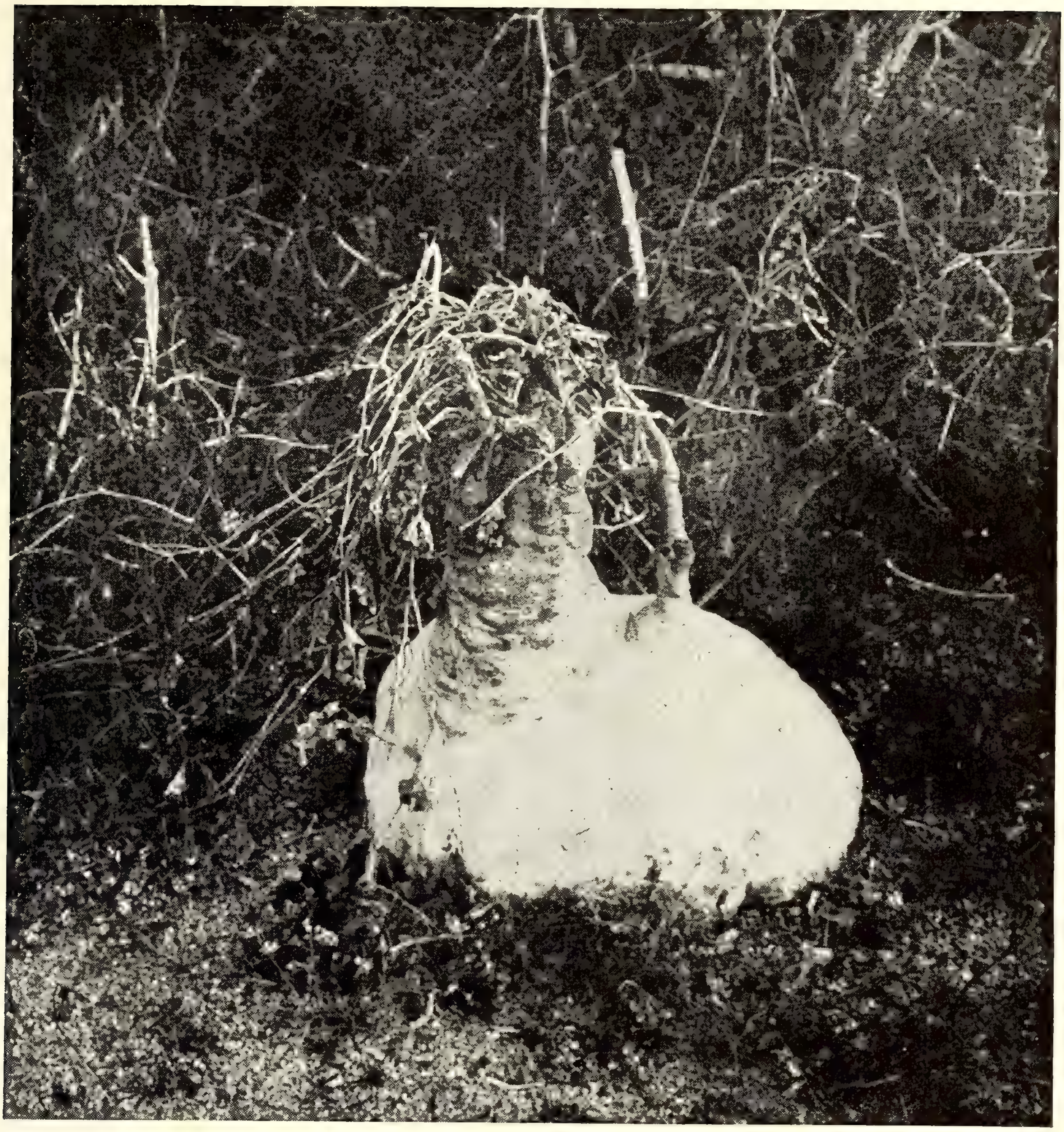
WESTERN GULLS (*Larus occidentalis*) ON THE BEACH: SAN MARTIN ISLAND, NEAR SAN QUINTIN BAY

These beautiful birds are savage and remorseless destroyers of the eggs and young of other birds breeding on the islands they frequent (see page 471)

the old and new worlds, and most of them have their homes about high and desolate mountain crests rising above the coniferous forests at timber-line, where they live amid arctic or semi-arctic conditions. Among the mountain sheep of Lower California these common conditions of life are reversed and they occupy the low desert ranges parallel to the Gulf coast from sea-level up to 4,000 or 5,000 feet altitude, always below the lower limit of the coniferous forests which adorn the upper levels of the high mountains in the northern part of the peninsula.

Here the summer temperatures are commonly much more than 100° Fahrenheit in the shade, and the arid mountain slopes have a scanty growth of cactuses, yuccas, Fouquieras, and other strictly desert plants. These sheep commonly go to water when available in the hot, dry summers, but are able to exist for considerable periods, even in hot weather, on the moisture obtained from the fleshy visnaga cactus, the tender flowers and flower stalks of agaves and yuccas, and from other water-storing desert plants.

During the last few years numerous American sportsmen have hunted these sheep in the barren mountains in the northeastern part of the peninsula. During this period the sheep have decreased considerably in numbers, mainly, however, through



A WATER-STORING PLANT (*Ibervillea*)

It has so much liquid stored that it can go on sending out vines, flowering, and fruiting years in succession without a drop of rain (see NAT. GEOG. MAG., August, 1910, p. 694)

indiscriminate slaughter by native hunters for the purpose of supplying meat to mining camps. Unless this kind of hunting can be rigorously suppressed and other hunting controlled, these splendid game animals are doomed to certain and early extermination.

THE HYDROPHOBIA SKUNK

In addition to the mammals already mentioned, wild cats, badgers, spotted skunks, raccoons, coyotes, and another kind of fox make their homes on the desert.

The spotted skunk, or hydrophobia skunk, as it is commonly called, is most abundant in the extreme southern end of the peninsula, where it is looked upon with fear and abhorrence, owing to its habit of biting people in the face while they are sleeping on the ground and the reputed commonly resulting death of the victim by rabies. The fear of these animals extends throughout the peninsula, and we were warned of the danger from them when we were preparing for the trip.

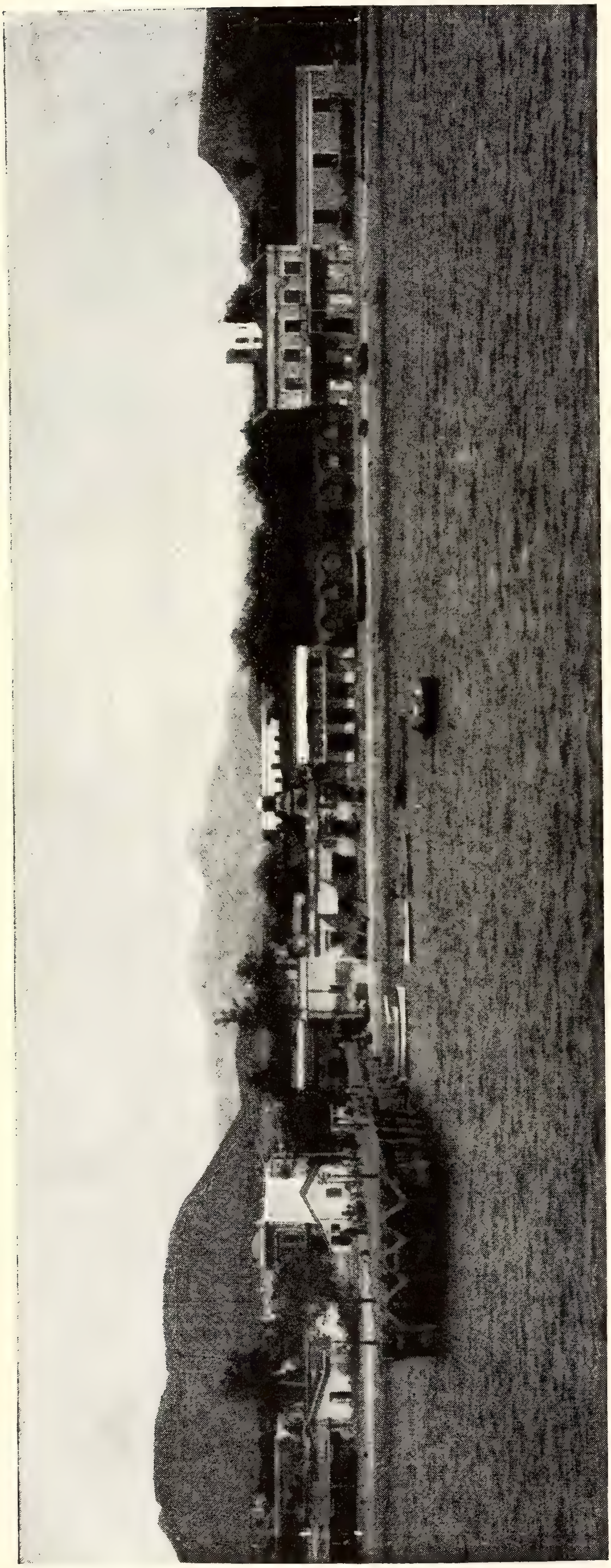
When we were at the village of Cape

San Lucas, the first of January, one of the villagers brought me the body of one of the skunks, which had entered the open door of his house the preceding night and bitten his little girl through the lip. The child was brought to me the next day and the two marks where the skunk's canines had pierced the lip were already healing without inflammation. I have no further knowledge of the outcome in this case, but was told of the death of one of the men of the village the previous year from a similar bite.

FRIENDLY QUAIL AND RAVENOUS GULLS

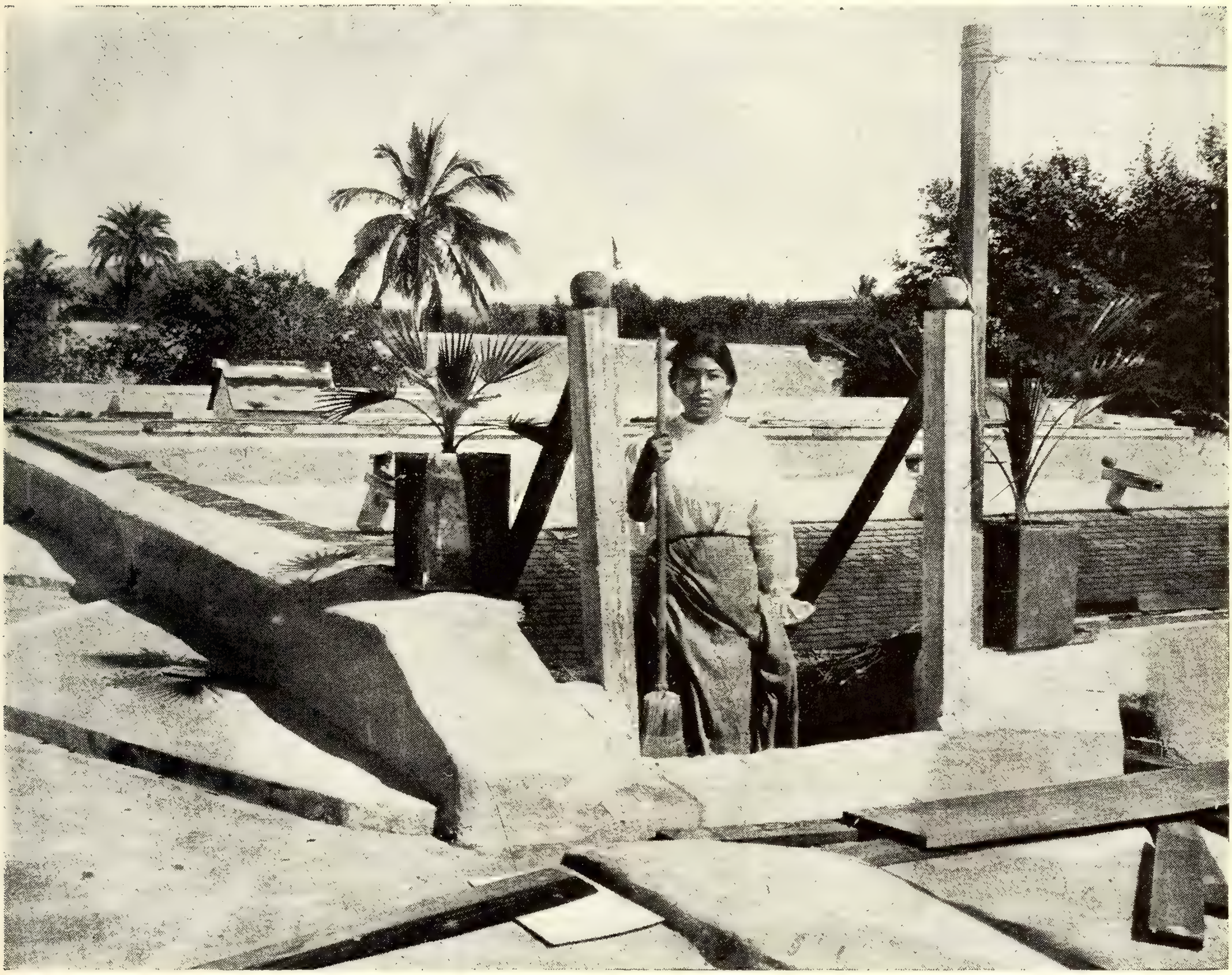
Doves and California Valley quail were numerous the entire length of the peninsula, their presence always indicating the vicinity of permanent water. One of the most attractive sights about our camps at desert waterholes was the trooping in of these birds to drink. They were so unaccustomed to man and his ways that they were entirely unafraid, and after drinking the quail stood quietly preening their plumage, or moved carelessly about, uttering little subdued call-notes to one another.

Hawks, woodpeckers, jays, ravens, fly-catchers, cardinals, mocking-birds, cactus wrens, and other small birds enlivened the desert and were abundant about some of the cultivated oases. A desert



SEA-FRONT OF LA PAZ, THE OLDEST AND MOST ATTRACTIVE TOWN IN LOWER CALIFORNIA

It is the capital of the southern district, and has always been the center of the pearl fisheries of this region. The United States coaling station, in Pichilinque Bay, is located a few miles north of La Paz, on the east side of La Paz Bay (see pages 455 and 457)



LOOKING ACROSS THE ROOFS OF LA PAZ, WITH A NATIVE SERVANT AT THE TOP OF STAIRWAY LEADING TO THE LOWER FLOOR

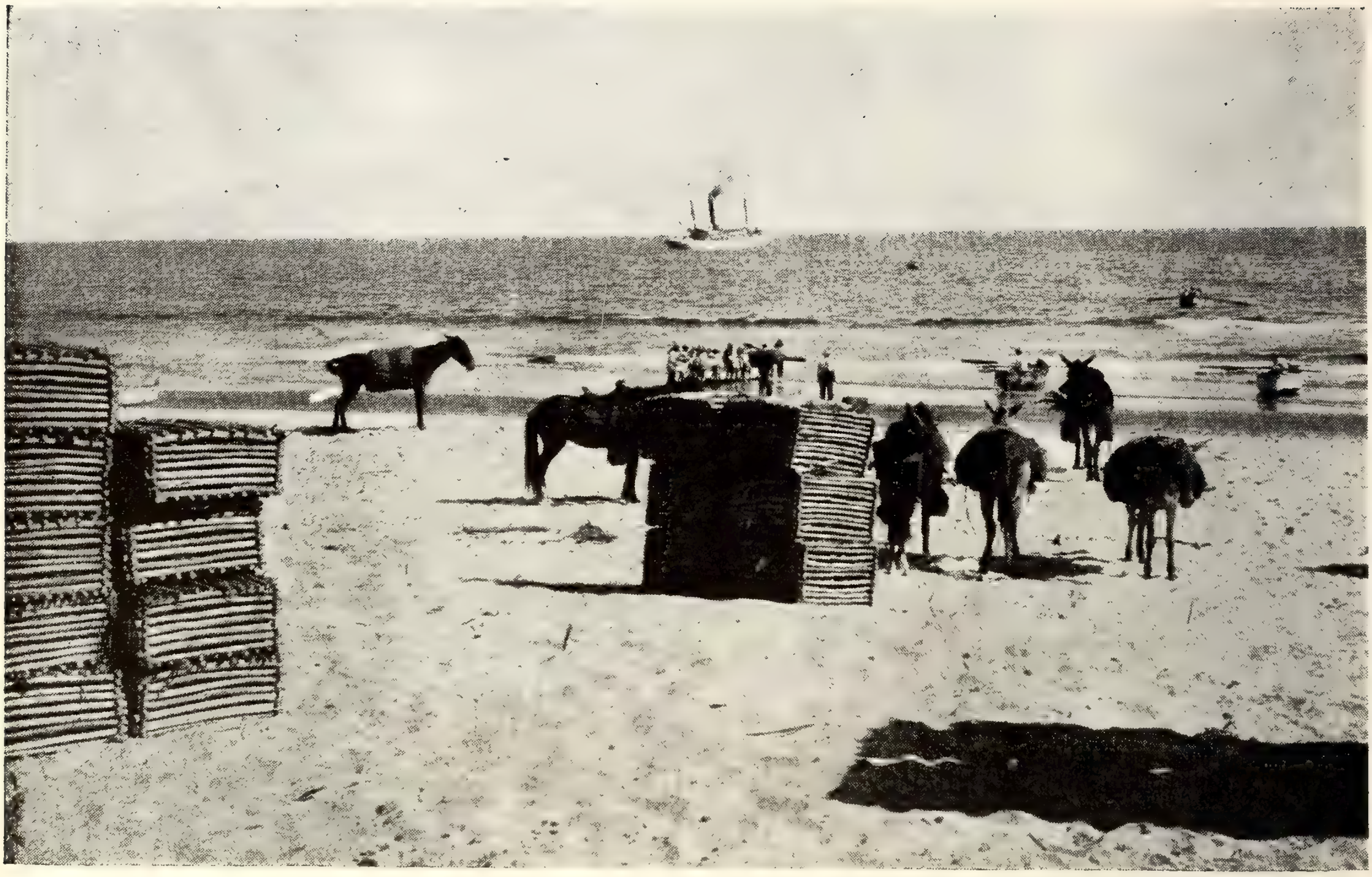
thrasher was abundant in the yucca forest near Santo Domingo Landing, and in early morning and evening charmed us by its exquisitely musical notes.

On San Martin Island, near San Quintin, in July, we found many cormorants breeding, with some families of young in the nests. While we wandered over the island we were accompanied by a low-flying escort of western gulls.

Whenever a cormorant, alarmed by our approach, flew away, the gulls swooped down on the exposed eggs and ate them at once; or, if we were too near, each gull transfixed an egg on its beak and flew away, draining the contents as it went. On two occasions I saw gulls alight on nests and calmly pick up young cormorants weighing 5 or 6 ounces each and swallow them entire, the helpless victims being swallowed head foremost, their feet waving despairingly from the gull's widely spread beaks as they disappeared.

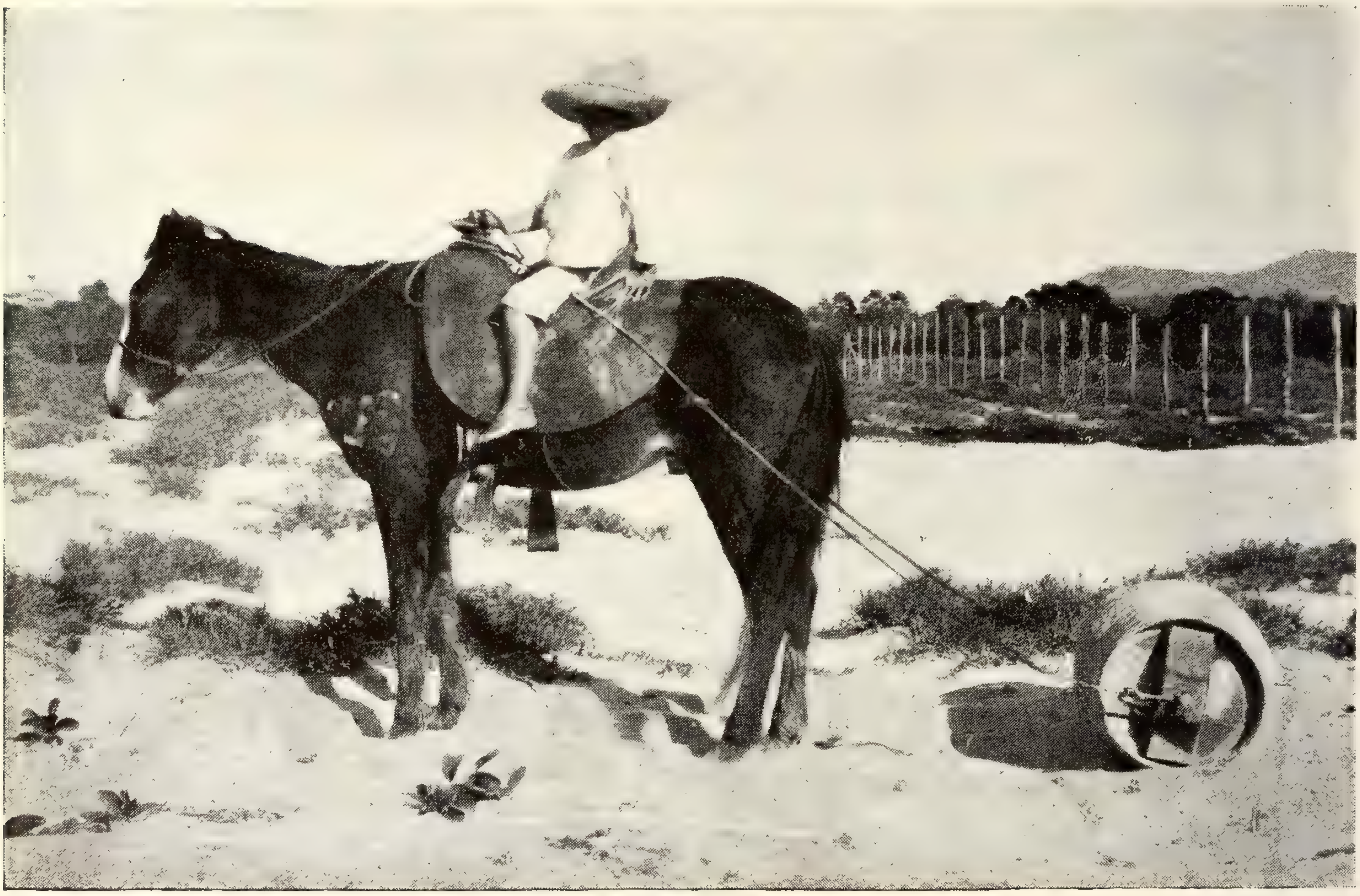
THE CALIFORNIA CONDOR

While at La Grulla meadow, in the San Pedro Martir Mountains, we were fortunate enough to secure our first California condor, a huge bird, sometimes measuring nearly 11 feet across its outspread wings. We afterwards saw others and had a most enjoyable experience watching a dozen or more of them in superb flight as they swept back and forth over the pine forest or soared up and disappeared in the blue sky. When these birds were perching on a dead tree the turkey buzzards near them looked like pygmies.



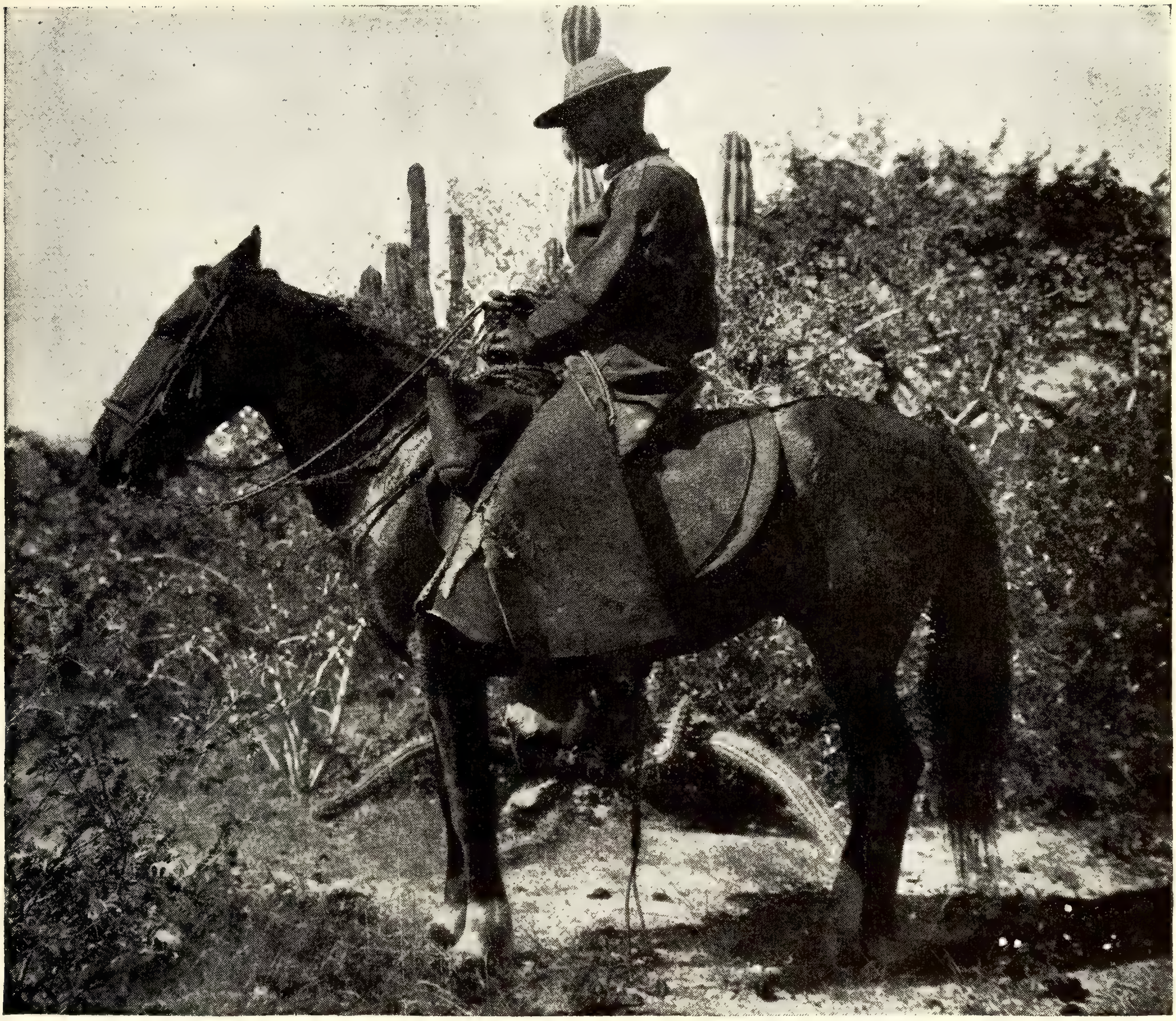
LANDING PLACE ON OPEN BEACH AT SAN JOSÉ DEL CABO

Crates of brown sugar in small cakes for export have just been unloaded from the pack animals. This town contains about 1,600 people and is situated in a fertile valley at the extreme southern end of Lower California.



ROLLING WATER-BARREL AT SAN JOSÉ DEL CABO

A ring on the end of the rope at each end of the barrel is placed over the head of a projecting bolt and the water-filled barrel then trundled after the horse. Ranches are sometimes supplied with drinking water in this manner from a spring or water-hole several miles away.



COWBOY IN SOUTHERN LOWER CALIFORNIA

He is wearing the usual leather-covered hat, leather jacket, and leather aprons over his legs to guard against the thorny vegetation. Frequently the horses have a leather apron hanging over their breasts for the same purpose.

The natives formerly cut off the large hollow bases of the quill feathers of these gigantic birds and, fitting them with stoppers, used them for carrying fine gold at the placer mines.

Owing to its desert character, the peninsula is thinly peopled and enormous areas remain uninhabited. The most populous section was the region south of La Paz, where rains are more regular than farther north. A few small towns and widely scattered small communities along the coast, with a limited number of villages, ranches, and miners' camps in the interior, cover the population. That repeated unsuccessful and usually ill-advised efforts have been made to conquer the desert was evidenced by the many deserted and ruined ranch-houses we passed on our route.

The tale of unbroken failure of the efforts made during the last 50 years to establish agricultural colonies in Lower California is sufficient evidence of the stern desert conditions which prevail. A few propitious rainy years have encouraged visions of success, but the succeeding rainless years have brought disaster with them.

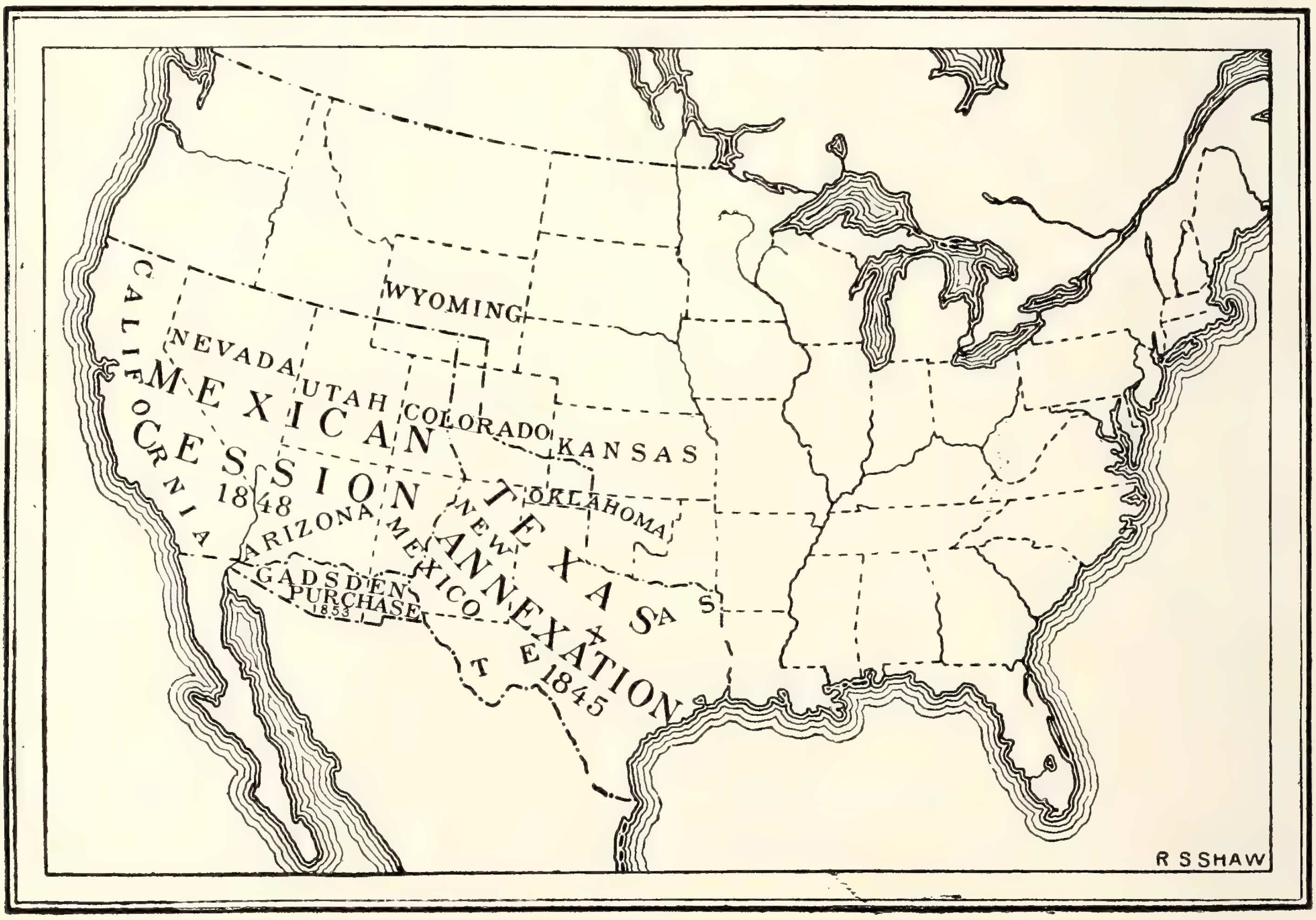
In addition to climatic discouragements, the early missionaries encountered other troubles, for Padre Baegert, who lived from 1751 to 1767 in the southern part of the peninsula, tells of great plagues of grasshoppers, which swept from the south toward the north, obscuring the sun by their numbers and making a noise like a strong wind. He says they devoured all green things as they passed over the country.

MANY PARTS OF LOWER CALIFORNIA ARE CAPABLE OF RICH DEVELOPMENT

Although the foregoing account of conditions prevailing in Lower California appears to indicate a hopeless desert, yet almost without exception where agriculture has been tried intelligently, with a sufficient water supply developed for irrigation, the soil has responded bountifully. The possibilities of agriculture were proved centuries ago by the missionaries located in valleys, where water from large springs enabled them to grow wheat and many other crops. At present peas, beans, corn, cotton, tobacco, sugar-cane, grapes, bananas, figs, oranges, lemons, limes, pomegranates, dates, olives, and other fruits and vegetables are grown.

The hot, dry climate and other conditions of the middle and southern parts of the peninsula lend themselves especially to the cultivation of the choicest varieties of date palms and to numerous tropical fruits.

The largest and most important single area of agricultural development will no doubt be about the delta of the Colorado. The storage of surface water and development of the underground supply should render considerable areas productive on the plains of San Quintin and Magdalena. Wherever land is now irrigated in the older settlements, proper control of the available water would greatly enlarge the productive area. The greatest drawbacks at present to both mining and agricultural development of the peninsula are the unenterprising character of the native population and lack of transportation facilities.



OUTLINE MAP OF UNITED STATES, SHOWING TERRITORY ACQUIRED BY TEXAS ANNEXATION AND MEXICAN CESSION

OUR NEIGHBOR, MEXICO

BY JOHN BIRKINBINE

PAST PRESIDENT OF THE FRANKLIN INSTITUTE OF PHILADELPHIA AND OF THE AMERICAN INSTITUTE OF MINING ENGINEERS

With Photographs from the Author

IN discussing the truly interesting country which for 1,800 miles forms the southern boundary of the United States, the intention is to treat it in a neighborly spirit and neither as cynic nor apologist; to summarize some geographical and topographical features, indicate the nation's present position in commerce and industry; to recall a few historical facts, and tell of the people from an acquaintance of nearly 30 years.

The visits to Mexico, while far from covering all of the Republic, have been in connection with engineering problems, and have included cities, towns, pueblos, haciendas, ranches, or camps upon desert or among mountains, presenting opportunity for acquaintance with the various physical features, with the mineral wealth, and with the activities and environment of the people.

In formulating opinions I have had the benefit of an extended acquaintance in Mexico, and also of investigations by three sons who as business associates have visited the Republic, one residing in that country for the past five years.

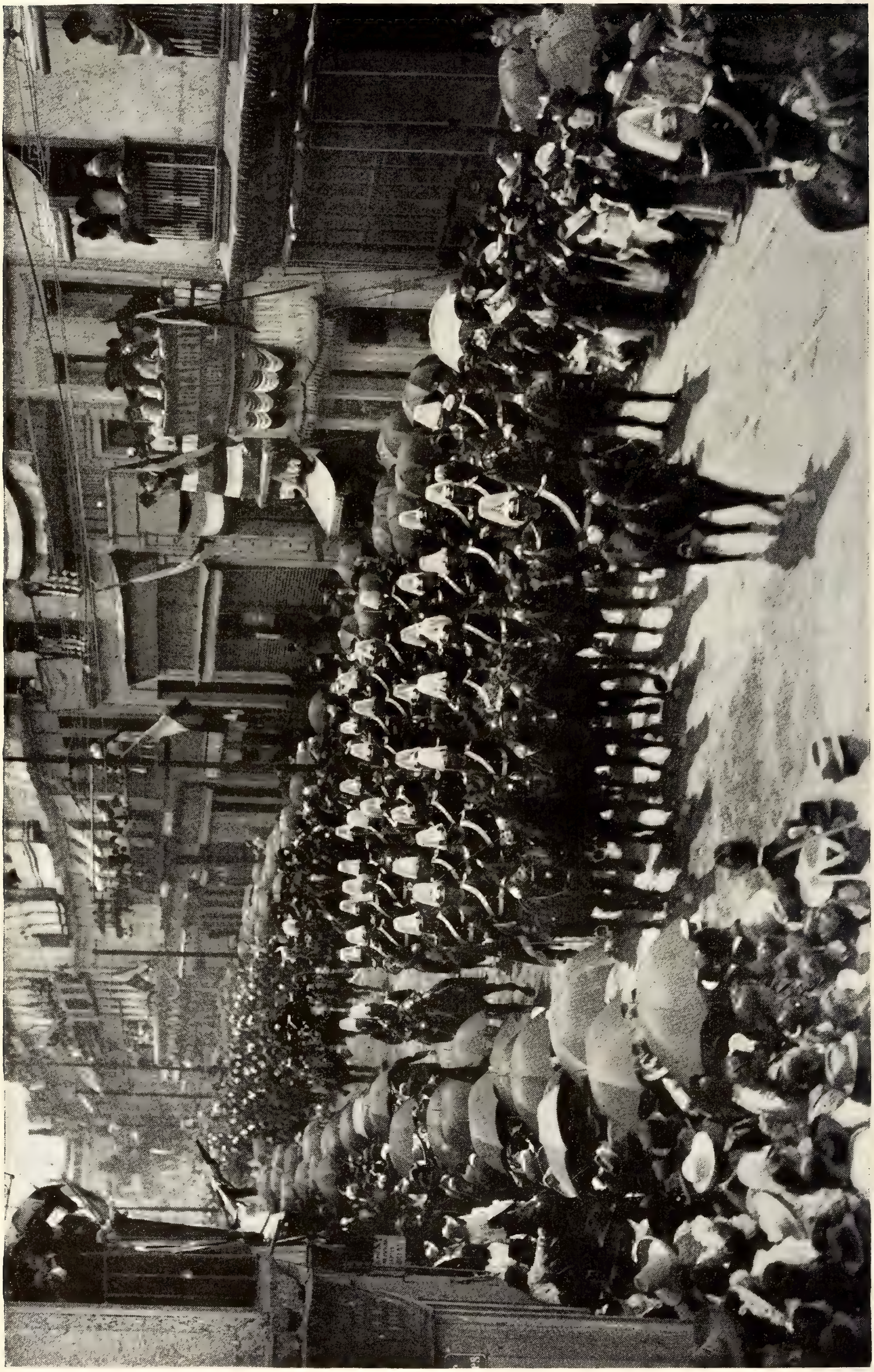
A résumé must necessarily be general which refers to territory practically as great as that of the United States between the Mississippi River and the Atlantic coast, the Great Lakes and Gulf of Mexico, varying in altitude from sea-level to 18,000 feet above this datum; its climate affected by these elevations, and by a range of 18 degrees of latitude. Twelve hundred miles is the distance traversed in passing south from Juarez, on the northern boundary, to the Mexican capital; and, to reach the southeastern boundary, 900 miles more must be covered.

To the coast line of 1,700 miles along the Gulf of Mexico and the Caribbean Sea is to be added 4,000 miles along the Pacific Ocean and Gulf of California.

MEXICO IS AS LARGE AS GREAT BRITAIN AND IRELAND, FRANCE, GERMANY, AND AUSTRIA-HUNGARY COMBINED

Prior to 1836, Mexico, as a Spanish colony, and the United States covered approximately equal areas of North America, but the Texas secession and the result of the Mexican War added nearly a million square miles to our territory, and the extent of Mexico now is less than one-fourth that of continental United States. But our neighbor Republic still has territorial expanse equal to the aggregate of Austria-Hungary, Germany, France, Great Britain, and Ireland.

The total area of the Republic of Mexico (767,000 square miles) is less than that of our five largest States—Texas, California, Montana, New Mexico, and Arizona—combined, all of these except Montana having been a part of New Spain 75 years ago. None of the 31 political subdivisions of our neighbor are as large as either of the five States named, but four Mexican States contiguous to the United States aggregate an extent greater than that of Texas. Chihuahua, the largest Mexican State, approximates in area (87,000 square miles) that of Utah, Sonora (77,000 square miles) of Nebraska, Coahuila (63,000 square miles) of Georgia, and Durango (40,000 square miles) of Kentucky. Nine subdivisions of the United States (excluding Alaska) are larger than Chihuahua, 15 of greater magnitude than Sonora, and 32 larger than Durango. The rugged and desert character of the Mexican border States support sparse populations, except where mining exploitation and cities resulting therefrom have concentrated settlement.



CAVALRY FROM THE MILITARY SCHOOL (THE WEST POINT OF MEXICO)

Scene in Mexico City during the celebration of the one hundredth anniversary of Mexico's independence, September, 1910

CADETS OF THE MILITARY SCHOOL (THE WEST POINT OF MEXICO)

A section of the Castle of Chapultepec (three miles from the Cathedral of Mexico) is occupied by the President for a portion of the year; but the major portion is devoted to a national military school. The valor of the cadets of this school when defending Chapultepec against the American army is historical.

CADETS OF THE NAVAL SCHOOL (THE ANNAPOLIS OF MEXICO)

While Mexico has an extensive coast-line to protect, its naval equipment is small

CARRIAGE IN THE BATTLE OF FLOWERS, CITY OF MEXICO, MAY, 1910, DECORATED IN RED, WHITE, AND GREEN, THE NATIONAL COLORS

Prominent Mexicans vie with each other in the floral ornamentation of their automobiles and carriages, and in the latter part of the day the congestion of vehicles demands slow movement and gives opportunity for friends in passing to bombard one another with flowers.

The mountainous ridge with limited littorals, which as a narrow peninsula extends southward about 750 miles from the United States boundary and separates the Gulf of California from the Pacific Ocean, is not a State, but is recognized as the territory of Baja California, which in area (58,000 square miles) closely approximates that of Florida. The Gulf of California and the shifting Colorado River practically isolate Baja California from the balance of the Republic and prevent overland communication with it. Tepic, on the Pacific coast (11,000 square miles), smaller than Maryland, and Quintana Roo, adjoining Yucatan, are other territories.

The average density of population in the Republic approximates 20 per square mile, the most thickly inhabited portions (outside of the Federal district) being the States of Tlaxcala and Mexico; the former (1,500 square miles) the smallest of the Mexican subdivisions (less than Delaware in size and of about the same density of population), the latter (8,900 square miles) being nearly as large as New Hampshire, but with more than twice the number of inhabitants.

The Federal district, modeled after the District of Columbia, but of eight times greater area, is surrounded by the State of Mexico, the large population of the capital (470,000) materially aiding in bringing the average to more than 1,200 per square mile.

YOUNG MEN'S CHRISTIAN ASSOCIATION BUILDING, CITY OF MEXICO: COST, $100,000

It is equipped with library, reading-room, class-rooms, gymnasium, swimming-pool, restaurant, and some 90 dormitory-rooms

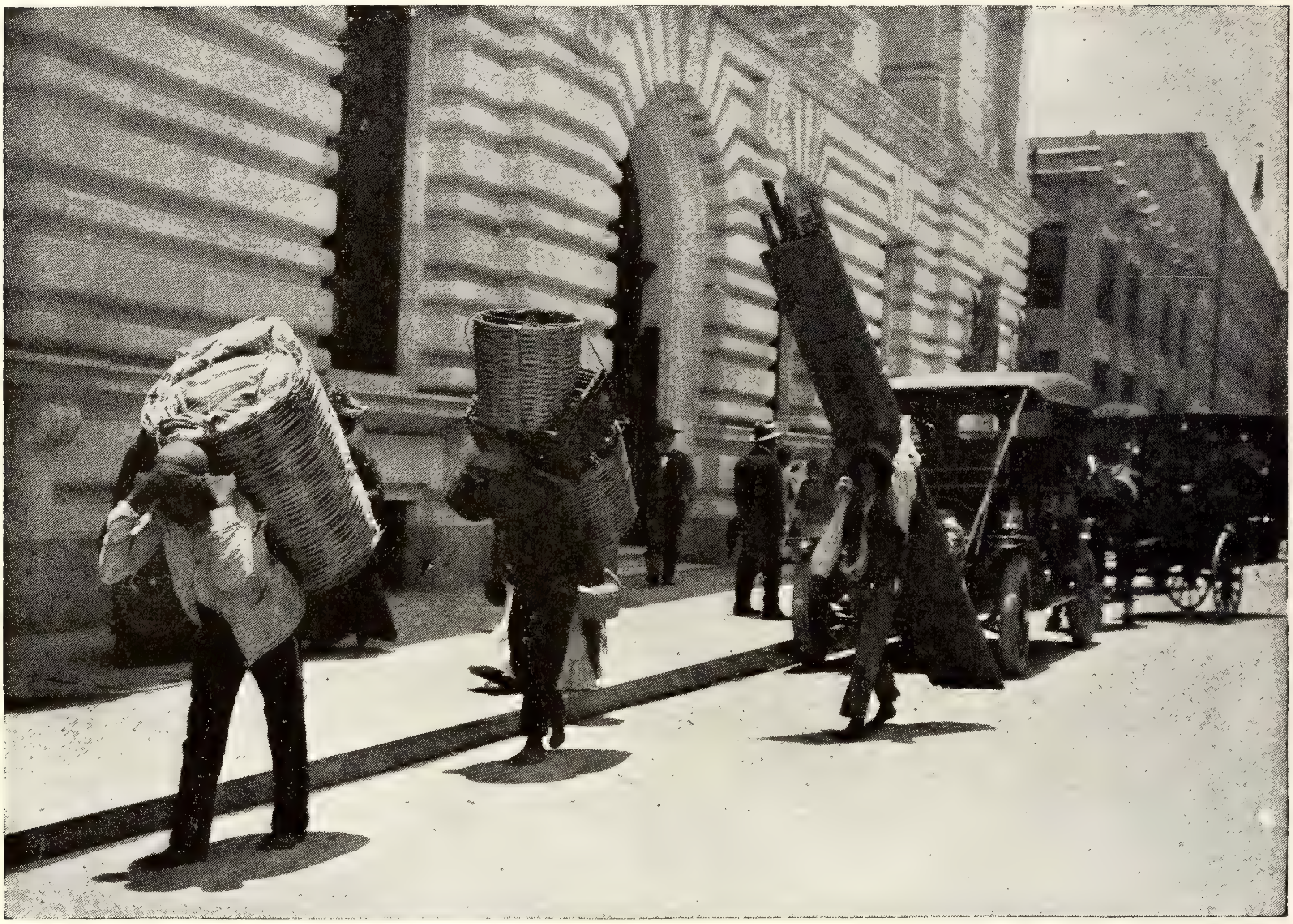
THE INTERNATIONAL BOUNDARY

The melting snows from the San Juan and Sangre de Christo ranges of the Rocky Mountains in southern Colorado form the genesis of the Rio Grande, which, after flowing south through New Mexico, bends southeast at the western extremity of Texas, courses between it and Mexico for a distance equal to that of Saint Louis from New York, and descends in 1,100 miles from an elevation of 4,500 feet to sea-level at the Gulf of Mexico.

Except when in flood, the Rio Grande is apparently an unimportant stream and readily crossed, for the normal flow is well utilized for irrigation in both countries; but it has carved in a part of its course canyons difficult of exploration. The changes wrought by freshets, which shift the channel, demand the attention of an international commission, whose function is to adjust the boundary along the Rio Grande to meet the varying conditions. The uncertainty of this is illustrated by a claim under investigation that a portion of the important city of El Paso, Texas, is Mexican soil. The remaining 700 miles of the international boundary to the west separating our neighbor Republic from New Mexico, Arizona, and California is through an arid desert section, much of which is mountainous. This is not a direct line, but has five changes in alignment, which have been accurately surveyed and established by 258 permanent monuments easily distinguishable.

Allowing for impassable canyons, mountain barriers, etc., probably 1,400 miles of boundary must be under surveillance to prevent smuggling, the passage of contraband articles, or violations of neutrality in emergencies.

Railways in Texas, New Mexico, and Arizona are close to the border, and these transportation avenues unite the two nations at seven points.



BURDEN-BEARERS, "CARGADERES," ON AVENIDA CINCO DE MAYO, CITY OF MEXICO

Note comparisons with automobile and carriage, and the ropes passing over the forehead, supporting much of the weight. The strength and endurance of the Mexican peon is almost beyond belief (see page 500).

TOPOGRAPHY OF MEXICO

The mountain ranges of southwestern United States continue into Mexico, and that country may be described as a high plateau, inclosed east and west by cordilleras, which approximately parallel the sea-coasts, from which they are separated by relatively narrow littorals.

The country is divided hypsometrically into the "tierra caliente," "tierra templada," and "tierra fria," the first comprising hot lands bordering the Gulf of Mexico, the Caribbean Sea, and the Pacific Ocean; the second forming the main plateau, bounded by the Sierras, whose more elevated portions are the third division. It is these mountain ranges, or offshoots of rugged topography from them, with intervening desert stretches, that have made communication difficult between portions of the Republic and interfered with railroad construction to cross the country transversely.

Among the mountains of Mexico are numerous volcanoes, all extinct or dormant except Colima, near the Pacific coast, which is active. In the central and southern part of the country earthquakes are of sufficient frequency to encourage the maintenance of an elaborate government seismographic laboratory.

The Sierras approach each other near the City of Mexico, and the adjacent States, although largely mountainous, maintain a population whose density is greater than in other portions of the Republic.

These mountains continue eastward, with Popocatepetl, Ixtaccihuatl, Orizaba, and Perote as prominent features, but are so reduced in height at the Isthmus of Tehuantepec that the railroad connects the Pacific Ocean and the Gulf of Mex-

AVENIDA CINCO DE MAYO, CITY OF MEXICO, SHOWING MUTUAL LIFE BUILDING AND THE UNFINISHED NATIONAL THEATER, WITH ALAMEDA GROVE IN BACKGROUND

This avenue extends from the National Theater to the main cathedral

ico in a distance of 192 miles* (but little greater than that from New York to Baltimore), with a summit about 700 feet above sea-level. The importance of this Tehuantepec railroad is emphasized by traffic valued at 70 million dollars, originating in or destined for the United States, carried in 1910, of which 20 million dollars was from Hawaii, mostly sugar, fully 140,000 tons of this commodity being shipped to Philadelphia (see also page 489).

The saving of 1,100 miles of transit and the enormous expenditures made for modern docks and equipment to facilitate handling freight, is Mexico's claim for preference over the Panama route.

THE HISTORY OF MEXICO

During nearly 300 years subsequent to the conquest by Cortés, Spain dominated Mexico, introducing arts—mainly, however, in connection with church architecture and embellishment—aqueducts, and bridges, and provided education, limited practically to the clergy or those preparing for clerical duties. Industries, except mining or such as produced material to enrich the Crown, were generally discouraged, and attempts by Mexicans to raise or manufacture anything produced in Spain were repressed.

A country whose resources had been improperly developed, in fact retarded; whose people had been impoverished to support a government in which they had no interest or part, and to construct and maintain a multitude of elaborate churches and allied institutions, and who had no experience in self-government, was in a poor position to become independent.

But the Spanish yoke was so burdensome, the enthralment of the Mexicans so oppressive, the poverty of the people so pronounced, and the resultant wealth of the church so great, that a century ago a bold effort for freedom was started, which, after many vicissitudes

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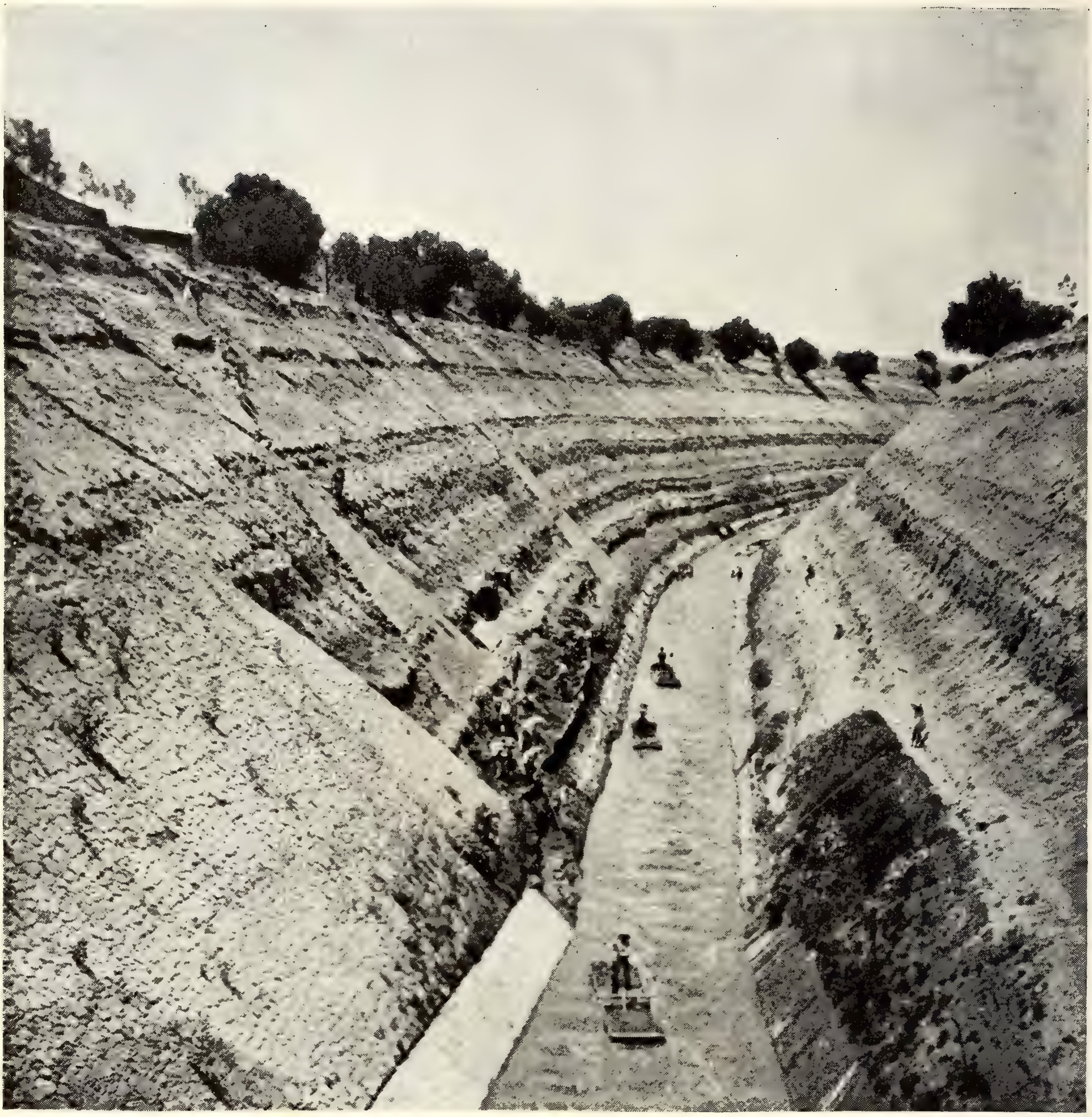
* The Isthmus of Tehuantepec was discussed in the NATIONAL GEOGRAPHIC MAGAZINE of December, 1910.



DRAINAGE CANAL AT ENTRANCE TO TUNNEL, VALLEY OF MEXICO

Note the depth of excavation, which was started by peons carrying material on their backs up the steep embankments by means of foot-holes. When this became unprofitable by reason of depth, steam dredges and aërial carriers, using coal costing $10 per ton, were utilized. The photograph shows peons carrying up the slope material for repair. The drainage system covers 50 miles, of which 30 miles are in excavated canal and 6 miles in tunnel.

and numerous revolutions, has become the Republic of Mexico of today.

The battle of Lexington preceded by 14 years the establishment of a definite government for the United States, with an elective President; and, although Mexico reckons its independence from 1810, this was merely the date when the priest Hidalgo struck the spark which started the patriotic flame resulting in Spain being driven from power; for 12 years elapsed before Mexico's initial home government was established with Iturbide as Emperor.

At that time Mexico claimed dominion over an area exceeded only by those of Russia and China, for it included Guatemala (subsequently separated), Texas, and all the territory north of the Rio Grande ceded to the United States by the treaty of Guadalupe Hidalgo and by the Gadsden purchase.

Iturbide held the throne for less than a year, abdicated, fled the country, to return and be executed as a traitor, and there followed a series of revolutions, each aimed to elevate to power some one who was soon assailed by equally ambitious competitors, for most Mexican revolutions have resulted rather from personal ambition than devotion to a principle.

A SUCCESSION OF REVOLUTIONS

More than half of the first century of Mexican independence was abortive, one coterie after another coming into temporary power, and a number of those acclaimed as rulers, after brief régimes, met ignominious death at the hands of the people they sought to govern.

Revolution succeeding revolution, some of national importance, others local emeutes, developed unsafe conditions for person and property and encouraged brigandage throughout much of the nation.

The effort to establish a monarchy under a European protectorate, while the United States was engaged in civil war, failed after three years, during which Maximilian scintillated in the glory of Emperor of Mexico; but this injection of outside influence into home quarrels undoubtedly hastened the time when Mexico took her place among the nations of the world. Having been accustomed to centralized power, a strong government seemed essential, by reason of former conditions and by the large proportion of the people considered as incapable of performing their functions as citizens.

A nation which had combated foreign foes and passed through many internal conflicts naturally relied to a great extent upon the military arm, and most of those who have directed or now control the affairs of Mexico have held army commissions. The standing army enrollment is about one to every 500 inhabitants.

FORM OF GOVERNMENT

The form of government adopted by Mexico follows in general that of the United States, having executive, judicial, and legislative divisions, and each of the 27 States is represented in two houses of Congress, composed of Senators and Deputies. Congress holds two sessions each year for limited periods, but maintains an organization to act in emergency as advisory to the Executive and to plan the work of Congress between sessions.

Each State has its governor and legislature, and is subdivided into districts (or counties), over each of which a "jefe politico" is placed, the districts having subsidiary municipalities with magistrates, presiding officials, and councils.

The autocratic feature of the Mexican government which is so much protested may be largely due to the fact that governors of the various States hold office with the approval of the President; that jefe politicos of districts have similar relations to the governors of the States, and that the officers of the municipalities are generally controlled by the jefe politicos.

Successive re-elections of President Diaz have limited the number of changes in officials, some of whom have abused their powers to an extent which has caused emphatic expressions of dissatisfaction.

This condition existing in a republic may appear startling, yet it is not very different from the control exercised over portions of our own country, the variation being that in the United States many dominate by self-appointment or by the indifference of citizens, while in Mexico such have practically official endorsement and recognition and consequent responsibility.

The Mexican constitution prohibits slavery, acknowledges the citizenship of all native Mexicans and those born of Mexican parentage, and of naturalized foreigners who bear no allegiance to other nations. In practice the right of suffrage is limited and may be expected to remain so while a considerable portion of the inhabitants are uneducated, many speaking only remnants of ancient dialects, for the votes of such will naturally be dictated by the local "curé" or the "jefe politico."

Among the reforms demanded by intelligent Mexicans are greater liberality in matters of franchise, the abolition of punishment for purely political offences, and modifications in the treatment of untried prisoners.

Education is made compulsory, a million scholars being reported as attending preparatory schools; for, although in remote sections this education has more form than substance, there has been marked progress in this important acquirement for a self-governing people; and, as education advances, drastic measures unfamiliar to those residing north of the Rio Grande may be found unnecessary. Advanced studies are prosecuted in colleges by probably 10,000 students, and Mexicans are enrolled in many foreign universities.

The divorcement of church and state, carried out under Juarez, confiscated churches, monasteries, and nunneries, and prohibited religious processions and the wearing of distinctive ecclesiastical robes upon the streets or roads; but in remote sections there is evident laxity in the enforcement of these provisions. The method of worship, too, is not in accord with our appreciation of that of the Church of Rome, for the superstition and idolatry of the ancient Mexicans seems to maintain; fireworks, tinsel, gaudy dolls, and pictures being substituted for the crude forms carved from stone.

The church and state are independent, and Congress cannot pass laws prohibiting or establishing any religion. Hence, although the Catholic religion is accepted as that of the people, there is toleration of other creeds, and in many portions of the Republic flourishing Protestant missions exist, while in the capital a Young Men's Christian Association building costing over $100,000 was dedicated as a feature of the centennial celebration in September, 1910.

THE MEXICAN PEOPLE

Of the 16 million inhabitants, two-fifths claim direct descent from ancient tribes or families which are accepted as the basis of Mexican history, two-fifths are of mixed native and foreign blood, the remainder being classed under the common appellation of "foreign."

Throughout much of the country, and often within short distances of railroads, are remnants of some of the ancient native tribes or races, adhering to customs, methods, and speech of their ancestors.

Thus in Oaxaca are the Zapotecas and Mixtecas, the estimate for the two races being a half million, and a government publication mentions a dozen other families in the same State.

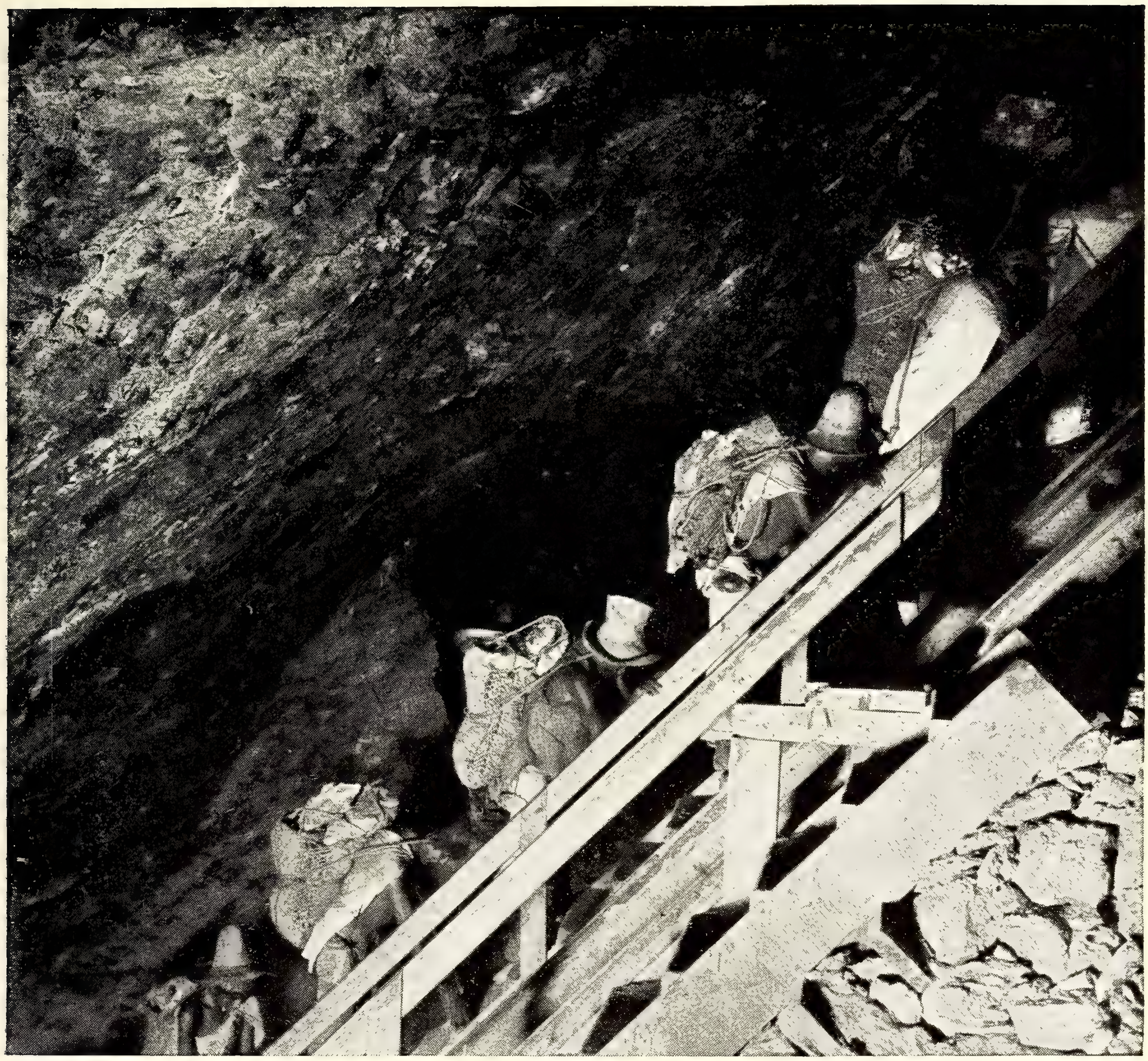
In Hidalgo and adjacent States, the Otomis; in Puebla and Oaxaca, the Mexicanos; the predominating Mayas in Yucatan; in Michoacan and Jalisco, the Tarascans, and the Tlaxcalans, in their native State, and other groups elsewhere, still maintain the tribal individualities.

Although Spanish is the language of the country, and much English is spoken in the regions most visited, a large number of the natives use only the vernacular.

Prescott refers to the Aztecs, Tlaxcalans, and others as producers of delicate fabrics, colored by vegetable dyes; intricate designs in the precious metals, and beautiful decorations made of feathers; numerous ruins also indicate marvelous skill of ancient peoples in stone-work, especially as the tools used were obsidian or copper.

Evidences that this deftness in handiwork has been retained appears in the feather-work, wood-carving, stone-cutting, etc., of the present day. The beautiful pottery and unique weaves of serapes, made with the crudest appliances, and excellent fabrications in cast or wrought iron, filagree silver, etc., also bear testimony to the skill of the Mexican Indian.*

*In the NATIONAL GEOGRAPHIC MAGAZINE for March, illustrations of some miniature dolls exhibit this deftness; and to these may be added the toy baskets and pottery, microscopic reproductions of the larger but excellent productions of the natives.



PEONS CARRYING ORE OUT OF A MINE

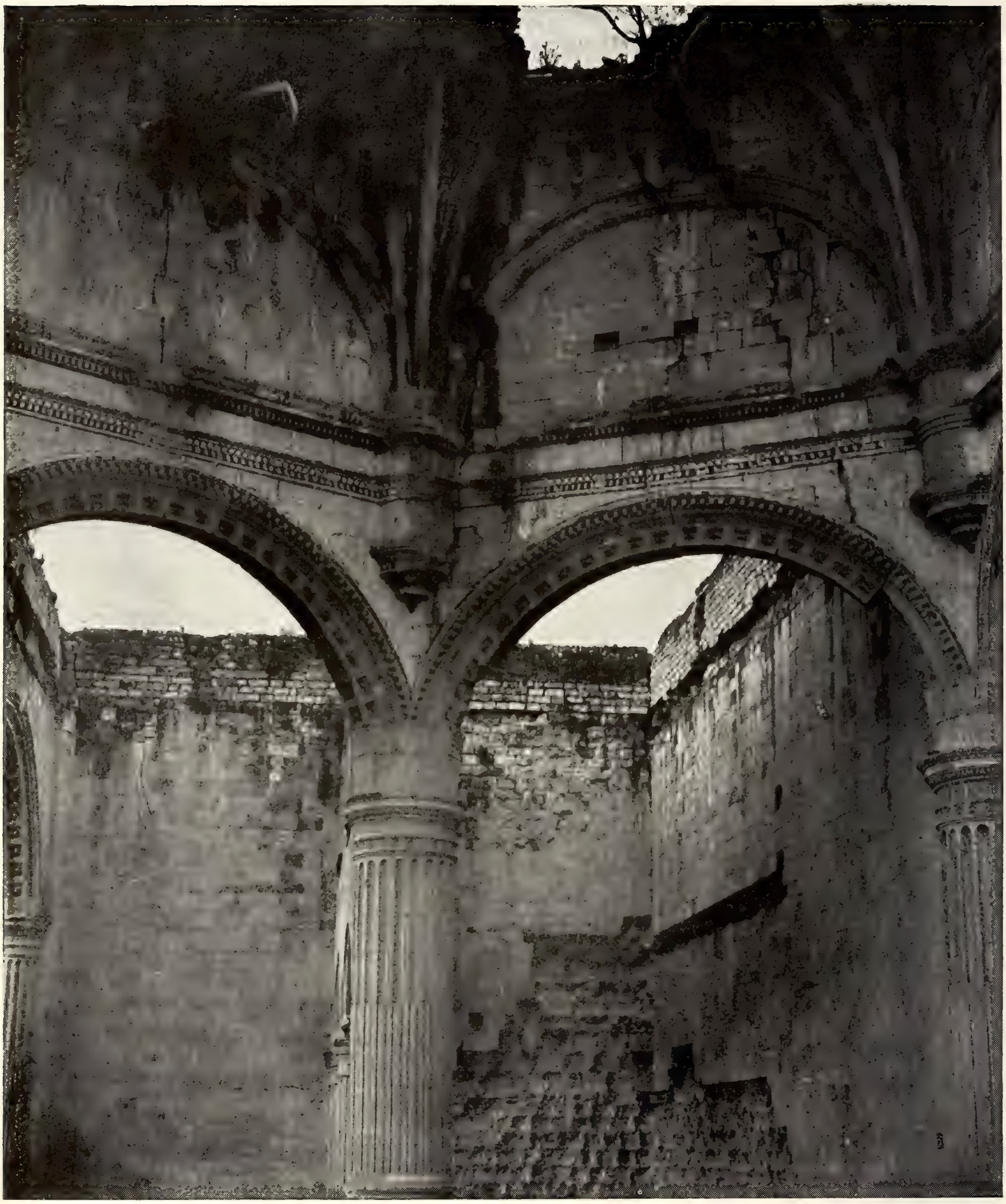
While this arduous labor continues in some mines, others are equipped with modern economical hoisting and pumping machinery

The Mexican people are decidedly democratic, living under a republican form of government generally accepted as autocratically administered. Prominent national characteristics, met with practically everywhere, are courtesy and politeness, evident equally to foreigners and among the people, independent of social condition.

The history of Mexico, engrossing whether considered as founded on substantial testimony or tempered by romance; the country's record of mineral wealth; its variety of soil products; the habits and customs of its people, many of them strange to visitors, must be passed in hurried review.

A COUNTRY OF EXTREMES (SEE ALSO PAGE 500)

Mexico may be described as a land of surprises, a country of extremes, a nation of contrasts, a domain of apparent contradictions; where the old and the new, the poor and the rich, the crude and the refined, are near neighbors; where the sleep of centuries often continues adjacent to present activities, and where ultra conservatism is elbowed by pronounced evidences of modern progress. Space will permit mentioning but few of the surprises—of conditions influenced by extremes of altitude, temperature, or rainfall; of contrasts of product, people, methods, environment, and development,



UNFINISHED CATHEDRAL AT TEPOSCOLULA, OAXACA

Note the excellent stone masonry, the columns being divided vertically and horizontally to facilitate carrying the sections as they had been transported many miles on the backs of animals.

and of the contradictory charm created by these.

In contrasting the governments and peoples of the United States and Mexico, we must consider that in the one case claimants for religious freedom sought a country where this could be and has been enjoyed, while in the other the na-

OLD CHURCH IN WESTERN OAXACA

Note the absence of adjacent habitations and bells in the tower

tives were enslaved by foreign expeditions of doubtful authority and kept in bondage for three centuries.

The United States owes its development to colonies of God-fearing home-seekers, prepared to win the products of the soil by hard work, while greed for wealth and renown, coupled with a fanatic zeal for a religion whose precepts he apparently failed to personally apply, encouraged Cortés in his conquest of Mexico.

Whether we accept Prescott's remarkable narrative or his critics' contentions, the skill, diplomacy, and courage of Cortés and his followers must be admitted, their shrewdness and persistence admired, their duplicity and cruelty condemned.

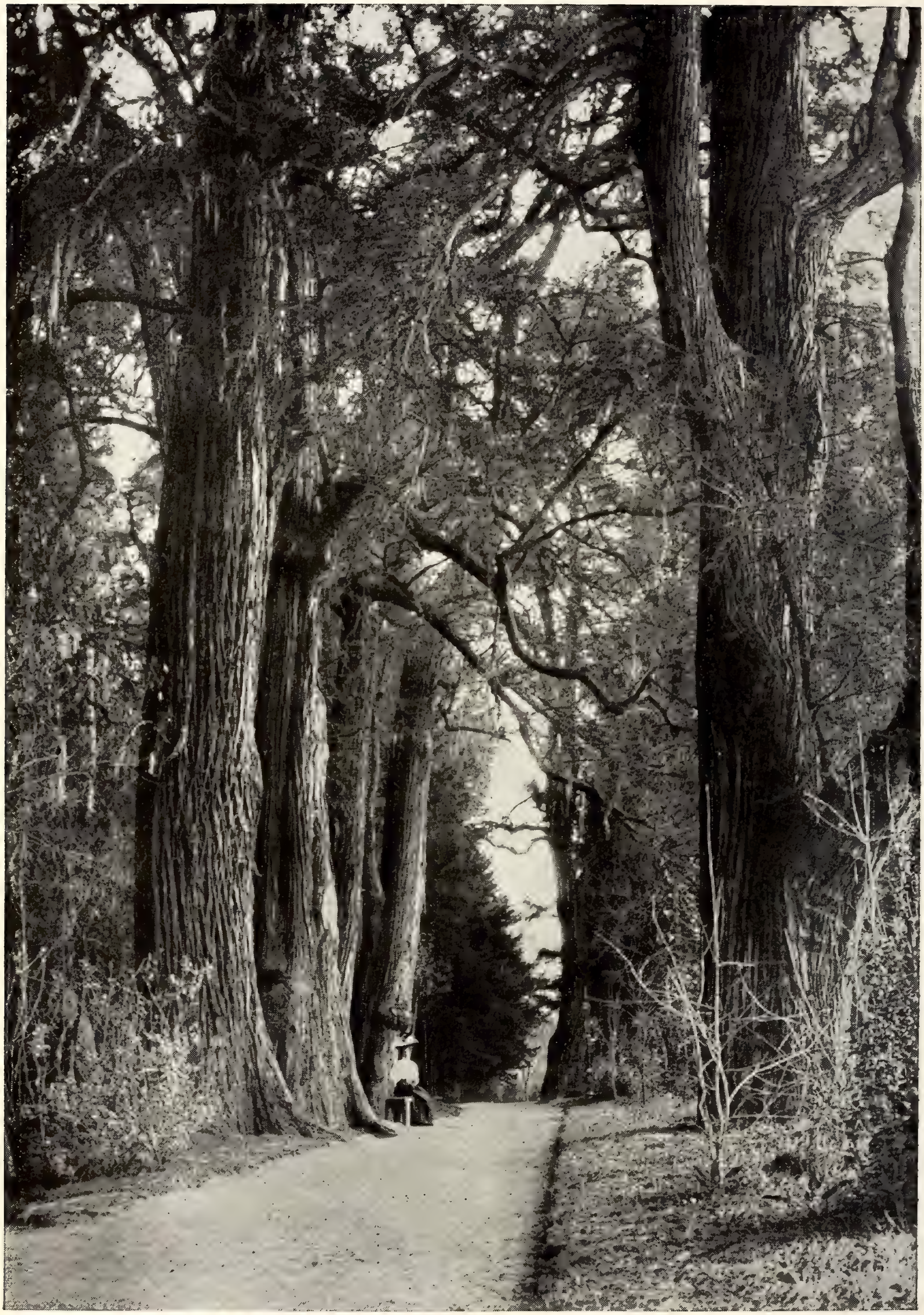
The story of the conquest of Mexico may be overdrawn, the odds against which the Conquistadores fought magnified, the victories made too lurid, and the defeats minimized; but the fact remains that multitudes of the Aztecs and other tribes were vanquished by a relatively small Spanish force.

Whether the status of civilization generally accepted was as advanced as claimed should not lessen appreciation of the fact that Cortés found a people superior to those who 25 to 30 years before met the early discoverers of North America.

An interesting feature of the celebration in September, 1910, of the centenary of Mexico's independence was a representation of types of the people who populated Mexico at the time of the Conquest; but these were not the oldest inhabitants of which there is record.

ANCIENT RUINS ABOUND

Mexico has a wealth of archeological relics, remnants of an ancient civilization of which no well-defined trace exists. Volumes have been written to demonstrate that the builders of what are now ruins were of Mongolian, Semitic, or Phœnician origin, but the riddle cannot



PATH IN CHAPULTEPEC PARK, SHOWING CYPRESS (SABINO) TREES

This cypress grove surrounds the Castle of Chapultepec and abounds in picturesque walks and well-kept drives. In the afternoons of Sundays and feast days these drives are crowded with vehicles and equestrians.

be admitted as solved. All authorities, however, unite in praise of the magnitude and the perfection of workmanship shown at various ruins found throughout the Mexican territory. The region adjacent to some of these raises question as to the source of sustenance for multitudes which must have then existed, and causes speculation upon ethnologic if not physiographic changes which may have occurred in the interval.

Prominent among these ruins are Uxmal and Chichen-Itza, in the State of Yucatan; Palenque, in the State of Chiapas; Mitla,* in the State of Oaxaca, and Xochicalco, in the State of Morelos.

The pyramid of Cholula, in Puebla, and those of the Sun and Moon, in the State of Mexico, have also been liberally described, but distributed over wide areas are many other ruins which have had but little or no investigation, and rock sculptures, images, idols, and ancient pottery, found in numerous localities, are the only records of peoples whose history is unknown and whose names even are lost.

TO MEXICO BY WATER AND RAIL

The facility with which Mexico can be reached by all-rail routes encourages a considerable majority of visitors from the United States to use them, but the regular lines of vessels plying between the ports of our country and Europe and Mexico are liberally patronized.

The steamship route from New York to Vera Cruz, after rounding the Florida keys, varies little from a straight southwest line, as the calls at Havana, Cuba, and Progreso, Yucatan, are not divergences. (The longitudes of Havana and Columbus, Ohio; of Progreso and Springfield, Illinois; of Vera Cruz and Dallas, Texas, or Emporia, Kansas; of Mexico City and Kearney, Nebraska, correspond closely.) The State of Yucatan, the thumb of Mexico, separating the Gulf of Mexico and the Caribbean Sea, is chiefly a low, flat country, a calcareous base covered with a limited earthy layer, renowned for its production of sisal fiber (nearly the entire output of the country being grown in Yucatan) and for archeological ruins.

The capital, Merida, a well-built city, having paved streets, sewage, water supply, and electric lights, lies less than 30 miles inland from Progreso, with which it connects by a railroad. Remnants of an ancient stone-encased mound, a cathedral about 400 years old, and water caverns in the limestone, are features of interest. Earth sufficient to support vegetation in the plaza and in patios of dwellings had to be brought 20 miles, as the lime rock is close to the surface.

The present site of Vera Cruz is not that originally selected by Cortés, and its harbor improvements have materially advanced the port. Although buzzards are still protected as allies of the board of health, sanitation has done much to reduce the danger from "vomito."

The City of Mexico, 264 miles (by rail) west of Vera Cruz, and 7,400 feet altitude, is reached by two rail routes, climbing from the hot lands through difficult mountain passes, one of which follows closely the trail taken by Cortés in 1519, by Gen. Winfield Scott with American troops in 1847, and over which, 15 years later, the invading French troops passed.

The topography in 75 miles jumps from sea-level to the snow-capped summit of Orizaba, nearly 18,000 feet above that datum, the climate varying from perpetual summer of the torrid zone to perennial snows on Orizaba, Popocatepetl, its neighbor Ixtaccihuatl, and other mountains (see also page 481).

CENTERS OF POPULATION

The settlement of Mexico is mainly in the central region, where two-thirds of the population inhabit one-quarter of the total area of the Republic. The capital is the most populous city, Puebla to the east and Guadalajara to the west of

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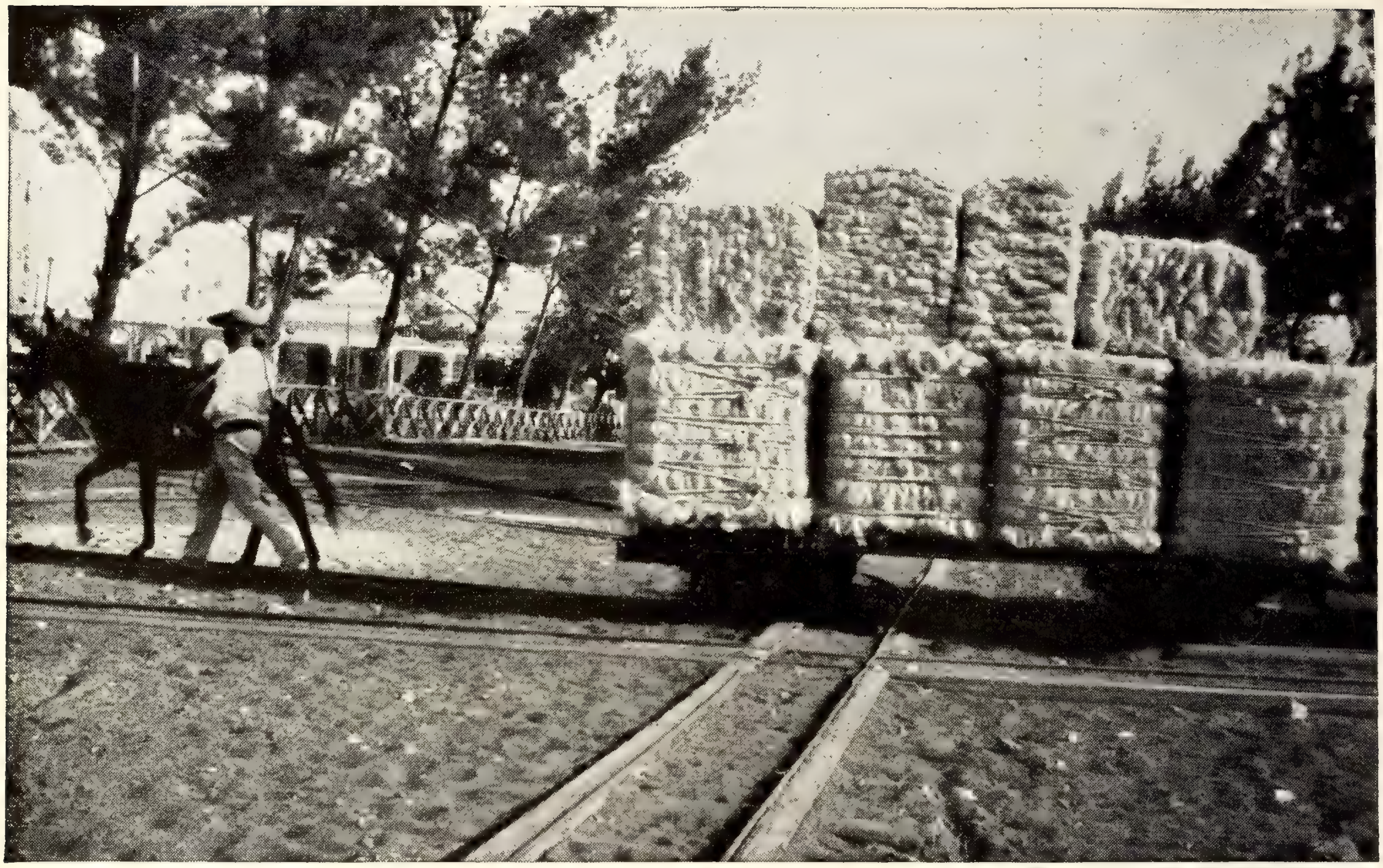
* The NATIONAL GEOGRAPHIC MAGAZINE for December, 1910, contains a suite of excellent illustrations of the Mitla ruins, the pyramid of the Sun and Moon, at San Juan Teotihuacan, and the Aztec Calendar Stone.

GIRLS IN PUBLIC SCHOOL: CITY OF TLAXIACO, OAXACA

A city of 8,000 inhabitants, located 85 miles from railroad and accessible by horse trail. The elevation of the city is about 7,000 feet above tide

BOYS IN PUBLIC SCHOOL, CITY OF TLAXIACO, OAXACA, A PROMINENT MUNICIPALITY IN THE COUNTRY OF THE MIXTECAS, WHO TRACE THEIR ANCESTRY TO THE THIRTEENTH CENTURY



MULE HAULING HENEQUEN FIBER: PROGRESO, YUCATAN

This is a product of an agave plant grown in large quantities in Yucatan, the bulk being shipped to the United States as a substitute for hemp in many specialties of manufacture.

the capital each claiming second place, with approximately 100,000 inhabitants. Monterey, with its growing industries; San Luis Potosi and Leon exceed 60,000 inhabitants. Other important cities—Guanajuato, Zacatecas, Pachuca, Chihuahua, Parral, Durango, Oaxaca—have developed from mining enterprises, while industries and agriculture are responsible for the growth of Merida, Aguas Calientes, Celaya, Irapuato, Torreon, Jalapa, Queretaro, Orizaba, Morelia, Saltillo, Hermosillo, Colima, and Toluca.

The more important ports are Vera Cruz, Tampico, and Puerto Mexico, on the Gulf of Mexico; Acapulco, Mazatlan, Manzanillo, and Salina Cruz, on the Pacific Ocean, and Guaymas and La Paz, on the Gulf of California.

Other localities maintain considerable coastal trade by using lighters plying between the shore and vessels in roadsteads, and some apparently favorable sites await projected railroad connections to encourage harbor improvements.

These numerous cities offer many attractive views, their ornate churches, handsome plazas, and industries each presenting features of interest. The mountains also are rich in scenic and impressive characteristics, and the types of people instructive.

WELL COVERED WITH RAILROADS

The bonds of steel, represented by 15,000 miles of railroad, constructed within the last 30 years—of which 55 per cent is owned or controlled by the government—have done much to unite the various portions of Mexico, but there is necessity for transcontinental lines crossing the Sierras, or connecting settlements along or near the northern border, where the country has its greatest width.

Of railroad mileage within the borders of the country, approximately one-half is between sea-level and 5,000 feet elevation, and about an equal amount between 5,000 and 10,000 feet. Few important cities are at lower elevation than 4,000 feet, and they range from this to 9,000 feet above sea-level, the most noted exceptions being the city of Monterey,

BUZZARDS ON MARKET-HOUSE: VERA CRUZ

These birds are the scavengers of offal about the streets, and as such are protected, although with the improved sanitary facilities their services are less essential than formerly

1,600 feet elevation, and the seaports or municipalities adjacent thereto. The governmental control of main transportation routes and of telegraph systems is a step taken with the expectation of keeping public utilities free from extraneous influences.

THE RIVERS OFFER MAGNIFICENT WATER POWER

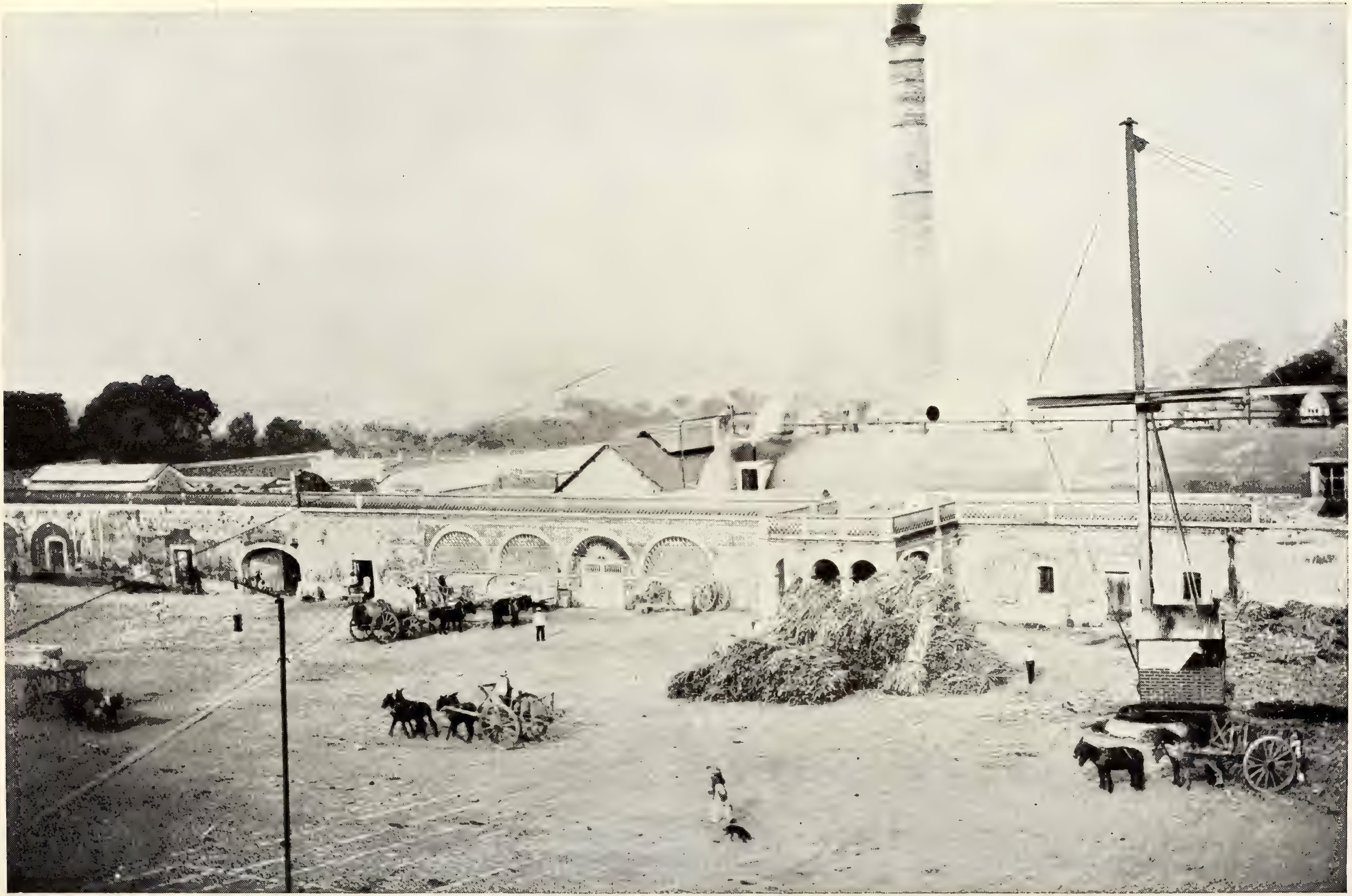
The topographic conditions offer some excellent opportunities for the development of streams normally of small volume but with abrupt drops, forming important water powers operating under high heads, of which advantage has been taken, and on some of the prominent rivers the descent is sufficiently rapid to encourage the utilization of large volumes with relatively low fall.

Many stream-beds are dry "arroyas," or "barrancas," except during brief intervals, when flood conditions temporarily transform these into rushing torrents, while the discharges of other rivers are fairly maintained throughout the year, and most water-courses have formed rugged canyons in the rocks or deep gashes in the alluvial plains. The number of important rivers is limited, and the rapid descent from the mountains to the coast permits navigation upon but few.

Throughout much of Mexico irrigation, which is liberally applied, is essential to assure satisfactory crops, and the extension of artificial watering is receiving attention.

The quantity and distribution of rain varies greatly throughout the Republic, the annual precipitation ranging from a few inches in the northwestern section to the total of 13 feet or more stated to occur on the Isthmus of Tehuantepec. In the northern desert regions many months may pass with little if any rainfall, or there may occur phenomenal downpours, such as reported at Monterey in 1909, when over 34 inches were registered in 140 hours. Records covering more than 30 years give the rainfall in the valley of Mexico, in which the capital is located, at from 13 to 36 inches annually, the bulk of which fell in June, July, August, and September.

But the valley of Mexico, 7,400 feet above sea-level, encircled by mountain chains rising 1,500 to 5,000 feet higher, with the snow-covered extinct volcanoes within 50 miles, has climatic conditions differing from that of other sections.



A TYPICAL SUGAR HACIENDA: STATE OF MORELOS, MEXICO

Note piles of sugar-cane, which have been brought in by the mule teams and are then handled by power derricks

BUILDINGS OF HACIENDA ATLACOMULCO, CUERNAVACA, MEXICO, BUILT BY CORTÉS AND STILL OWNED BY CORTÉS' ESTATE

This hacienda supported the first hospital built on the American Continent

THERE ARE FEW SOIL PRODUCTS WHICH CANNOT FLOURISH IN MEXICO

The Mexican flora include cacti of the desert,* varieties of fiber plants, wheat and maize of the temperate zone, cotton (which is indigenous), sugar, rice, coffee, vanilla, spices, medicinal plants and luxuriant tropical growths, citrus fruits, and berries, with flowers and orchids in endless variety. The variety of fruits and vegetables covers practically the list of other lands, due to the influence of topography and geographical location.

The vegetable products and the cattle raised in Mexico exceed in value 200 million dollars annually. The former includes corn (50 million dollars) and beans (6 million dollars), the popular foods of the country, all of which are used within its borders; wheat (13 million dollars), which is augmented by large importations; sugar and its products (13 million dollars), insufficient for the demands of the country; cotton (17 million dollars), representing but about one-half of the nation's consumption; coffee (8 million dollars), part of which is exported; henequen, the sisal hemp of commerce, most of which is shipped to the United States (16 million dollars); while other fiber plants add 2 million dollars to the country's exports. The tobacco crop is large, supporting, it is claimed, 600 factories.

The annual export of rubber from Mexico is valued at 13 million dollars, of which practically two-thirds is obtained from the rubber trees of the hot country and one-third from the shrub "guayule," which flourishes upon the desert plains of the great plateau.

The beverages used by the people, made from aguave plants and from cereals, are estimated at 10 million dollars per annum.

Upon the plains and among mountains sheep and goats in large numbers are

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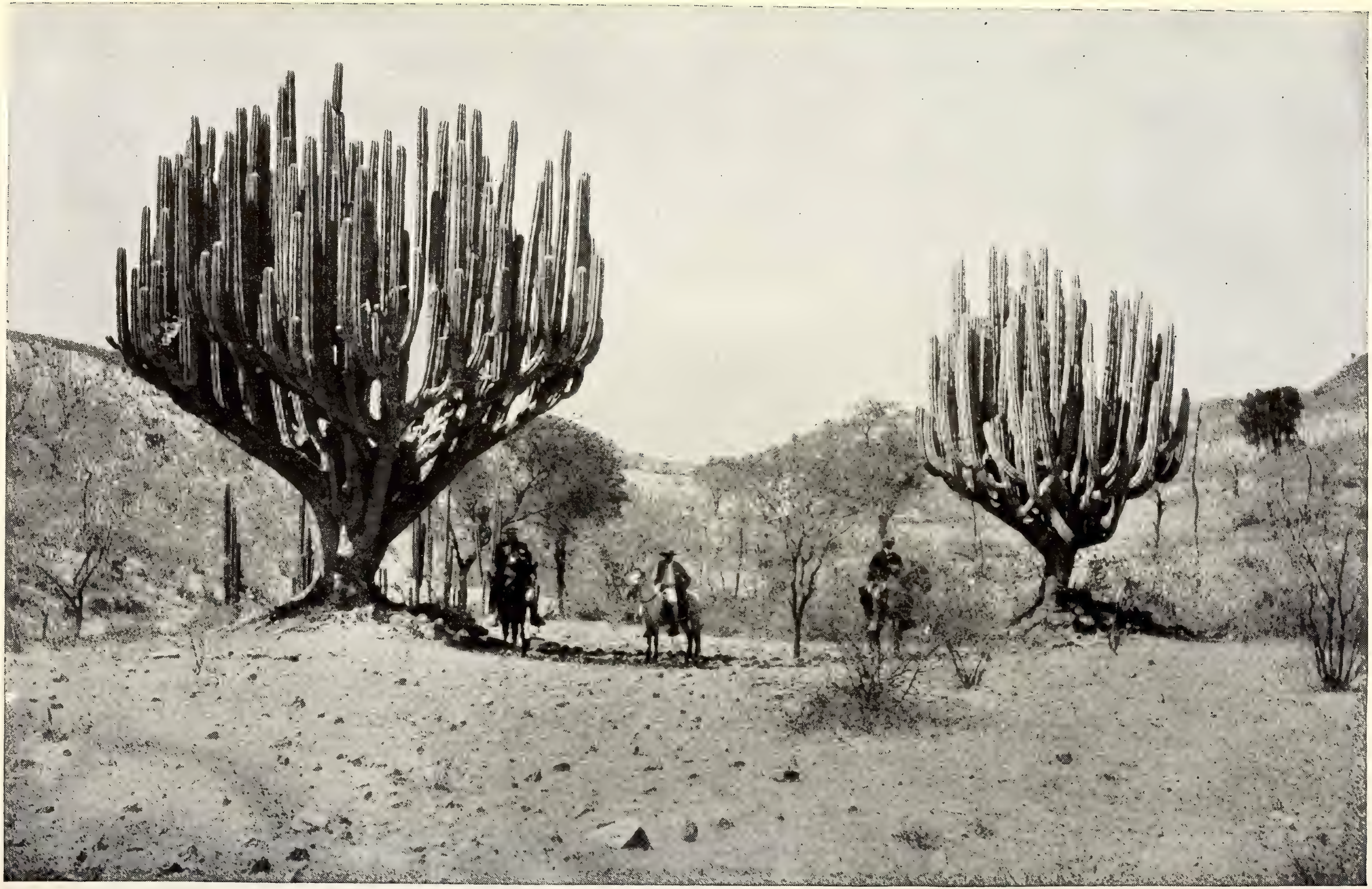
* The NATIONAL GEOGRAPHIC MAGAZINE for August, 1910, presented illustrations of some of the enormous cactus growths which are found in the desert lands and occur in many portions of Mexico.



CANDELABRA ORGAN CACTUS IN SOUTHERN PUEBLA

Note size of plant compared to horsemen. Others even larger exist in the vicinity. The view was taken on a well-used trail herded, the wool-clip being utilized locally for the production of serapes, rebosas, and sombreros, the hides tanned, and the meat consumed by the inhabitants. The individuality of design in serapes or blankets, like the color or forms of pottery, indicates the section of Mexico in which they are produced.

The forest products of the highlands embrace oaks, pines, palo-blanco (cottonwood), mesquite, and huisache, while the hot country supplies dye-woods, ebony, mahogany, and other hard woods valued at 5 million dollars annually. Dependence for centuries upon wood, or charcoal made from wood, as the source of fuel, has denuded much of the territory convenient to the more densely populated sections, and the timber demand for railways has also influenced the available forest area. But some mountain districts are well timbered and the government has inaugurated a systematic study of forestry.

There are few soil products which do not flourish or that could not be grown in Mexico, and the variety now obtained would be greater if closer attention were paid to cultivation and had not the growth of some important staples been prohibited while Spain ruled the country under its repressive colonial policy.

Mexico's foreign trade in 1910 exceeded 225 million dollars, nearly 130 million dollars representing exports, of which three-fourths were to the United States, Great Britain ranking second.

Of 95 million dollars in imports for the same fiscal year, three-fifths were from the United States, including boots, shoes, chemicals, machinery, coal, coke, cereals, mineral oil (although large deposits have recently been opened in Mexico along the Gulf), building woods, cotton in yarn, goods and manufactures, railway materials, and fabrications of iron, paper, etc.

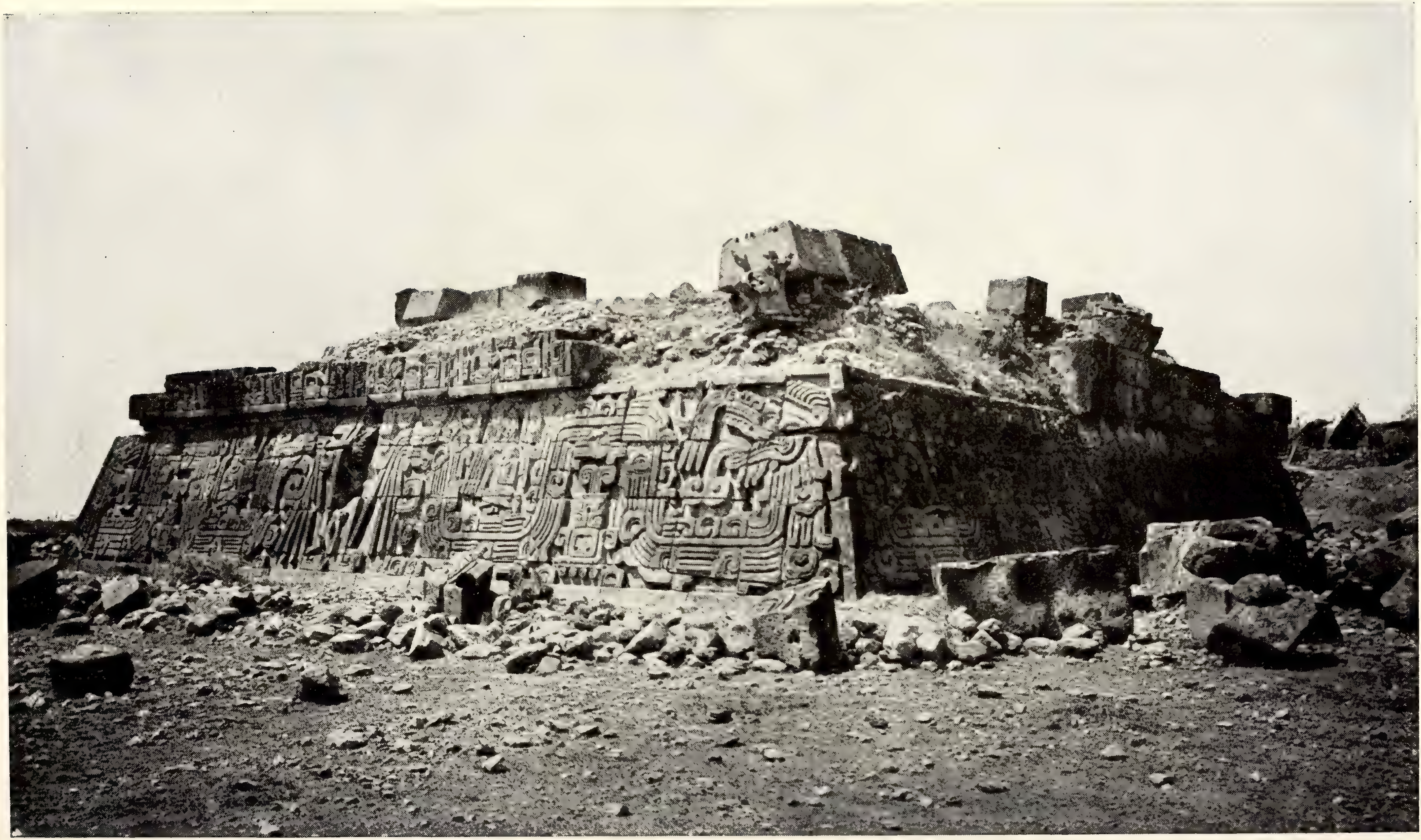
MEXICO LEADS THE WORLD IN PRODUCING SILVER

Mexico is pre-eminently *the* silver country, leading the world in producing "white metal" to the amount of 40 million dollars annually. Its output of copper, valued at 13 million dollars, is second to that of the United States, and, in the production of 3½ million dollars' worth of lead, it follows that country and Spain. Gold, mercury, tin, antimony, bismuth, iron, marbles, and sandstones are also mined, and the country possesses fields of mineral oil and valuable deposits of coal.

The coal mines in the State of Coahuila produce 1½ million tons of fuel per year, much of the coal being coked for the Monterey Iron and Steel Works and for silver smelters. About an equal amount of foreign fuel is imported, and late explorations have developed large quantities of satisfactory coal in the State of Oaxaca.

Among the famed Mexican deposits of precious minerals whose names promoters delight to conjure with are Santa Eulalia, Batopilas, Sombrete, Zacatecas, Cananea, Catorce, San Luis Potosi, Guanajuato, Pachuca, Real del Monte, El Oro, Taxco, and Oaxaca, interest in the history of some of these being stimulated by the wondrous tales of pavements of silver ingots, magnificent cathedrals built, and munificent gifts or loans to rulers by mine owners or operators.

In some of the Mexican mines, notched tree trunks still serve as ladders, and oxhides raised to the surface by animals operating "malacates" are used for drainage. In others the highest types of economic mining and pumping equipment have been installed at great expense, and improved methods of crushing and treating the ore, including vanners, tables, lixiviation, have displaced "arrastras" and the "patio," familiar features in Spanish methods of extracting the precious metals. Mules dragged heavy boulders around on a prepared bed of stones to crush the ore to a powdered sludge in "arrastras," and other mules or horses were driven about for weeks in patios over large masses of this sludge, to which copperas, salt, and mercury were added, so as to form an amalgam, which was recovered by washing.



RUINS OF XOCHICALCO, IN MORELOS

Note the carved stones, evidences of the handiwork of people whose identity is lost in the remote past (see also page 487)

A MOUNTAIN OF ORE

Iron ores are found in large quantity in many portions of the Republic, some deposits being of phenomenal proportions, as the Cerro de Mercado, just without the city of Durango, concerning which much that has been written as to it being a meteorite or a mass of metal must be qualified.

My initial visit to Mexico in 1882 was to examine and report upon this "mountain of iron ore," for such it is, and subsequent familiarity with the important producers of this mineral elsewhere give no reason to change the statement then made that "the Cerro de Mercado is the largest deposit of ore exposed above ground of which I have knowledge." The mineral is of non-Bessemer grade, approximating an average yield of 60 per cent of metallic content, and is employed in making iron as well as for flux in silver smelters.

Notwithstanding the abundance of excellent ores from which to produce iron, this metal may rank in cost close to others upon which we place higher values; and a feature of market days throughout much of the Republic is the iron merchant, who has spread on the pavement a heterogeneous display of old spikes, nails, keys, locks, and odd pieces of iron; for the average daily wage rate of the peon, equivalent to from 25 to 40 cents gold, will equal the cost of only a few pounds of scrap iron.

The domestic production of iron and steel, which falls far short of Mexico's requirement, is supplemented by liberal importations from the United States and Europe (the annual imports, exclusive of machinery, averaging 10 million dollars), but the processes used in Mexico cover the range from the crude Catalan forge to the modern blast furnace and steel works.

In the mountains of Oaxaca and adjacent States "ferrerias" produce from 25 to 50 tons of "platina" each per annum, by treating iron ore in an open charcoal fire, supplied with blast by a "trompe," the resulting "blooms" being wrought under helve hammers operated by water wheels. The fuel and ore are brought to and the metals taken from these ferrerias on the backs of men or animals. Other plants produce charcoal pig iron in cold or warm blast furnaces, and supply superior merchant bar from rolling mills whose puddling and heating furnaces are wood-fired, or make excellent castings in foundries. Others convert pig iron and scrap iron into steel in open-hearth furnaces, or melt scrap in gas- or oil-fired furnaces, and fabricate the product into various forms.

At Monterey a modern plant costing 5 million dollars has a blast furnace fed with coke, Bessemer converter, open-hearth steel furnaces, and rolling mills, manufacturing structural and merchant steel and rails, etc., amounting to 60,000 tons per year. Eighty-pound steel rails, made in the Monterey plant, are being laid on some Mexican railroads—an important step toward industrial independence.

THE MEXICAN PEON

Opportunity to observe the Mexican peons in cities and in various portions of the Republic, some remote from established avenues of travel, encourages favorable opinion of their ability and expectation of material advancement as education becomes general and ambition is encouraged.

Most writers apply phrases such as "dirty," "lazy," "thieving," to the peon. As a class the peon does not conform to our appreciation of cleanliness, although at every water-course they are observed making individual ablutions or laundering, and the methods of preparing and disposing of food fall short of our accepted standard. It is, however, possible that if we investigated the slums of our cities as tourists visit those of Mexican municipalities, there would be found many practices as offensive.

A lazy man does not travel at a trot, nor assume heavy burdens, nor does he utilize the time when driving a pack-train to add to his little store by braiding a mat or other article from palmetto or aguave leaves.

A Mexican assigned to a duty, as a rule performs it promptly and with integrity. He handles tools well, but follows precedent, and the uncertainty of action accredited to him is largely traceable to the observance of "fiestas" fixed by church or state, which too often are debauches, due to an abundance of "pulque" or "aguardiente."

Of moderate stature and of light build, he exhibits marvelous strength and endurance, especially as burden-bearer. Living in the land of Mañana, where everything is considered as put off until tomorrow, he moves with speed difficult for a good walker to equal. His quiet demeanor and mild speech give place to wild enthusiasm only at bull-fights, games of pelote, or when the Liberty Bell is sounded on the national anniversary; for the Mexican is a lover of his country, which until lately has done so little for him.

On the mountain, the peon trudging over difficult trails continues weaving a hat, stopping only long enough to doff his "sombrero" with a courteous and evidently cordial "*buenos dias.*"

As the civil marriage only is recognized legally, while the Catholic Church demands a religious ceremony, the formalities are often neglected, especially among the poorer classes.

The affection existing between parents and children, the love of flowers and of music, as manifest in the mountains as in the cities, contrasts with the national pastimes of cock-fighting and the bull-ring, and with the evident insensibility to the suffering of dumb creatures, which prevails.

Although some domestic animals are possessed by every peon able to own them, kept close to and often within the homes, bringing about an apparent affection between them and their owners, the latter would seem to show little interest in the suffering caused by long fasts, sharp goads, cruel spurs, or loads which are all the animals can carry, the friction of which is often the cause of sores upon the creature's body.

MANY CONTRASTS AND EXTREMES

Some of the striking contrasts, indicating extremes or contradictions, have been referred to, and others, which also suggest the peoples' democracy, may be of interest (see page 485).

A fashionably dressed gentleman precedes or follows on a prominent street of the capital or other large city a sandaled peon clad in linen trousers and blouse, his indispensable companion, the "serape," over one shoulder and his head protected by a wide-brimmed sombrero.

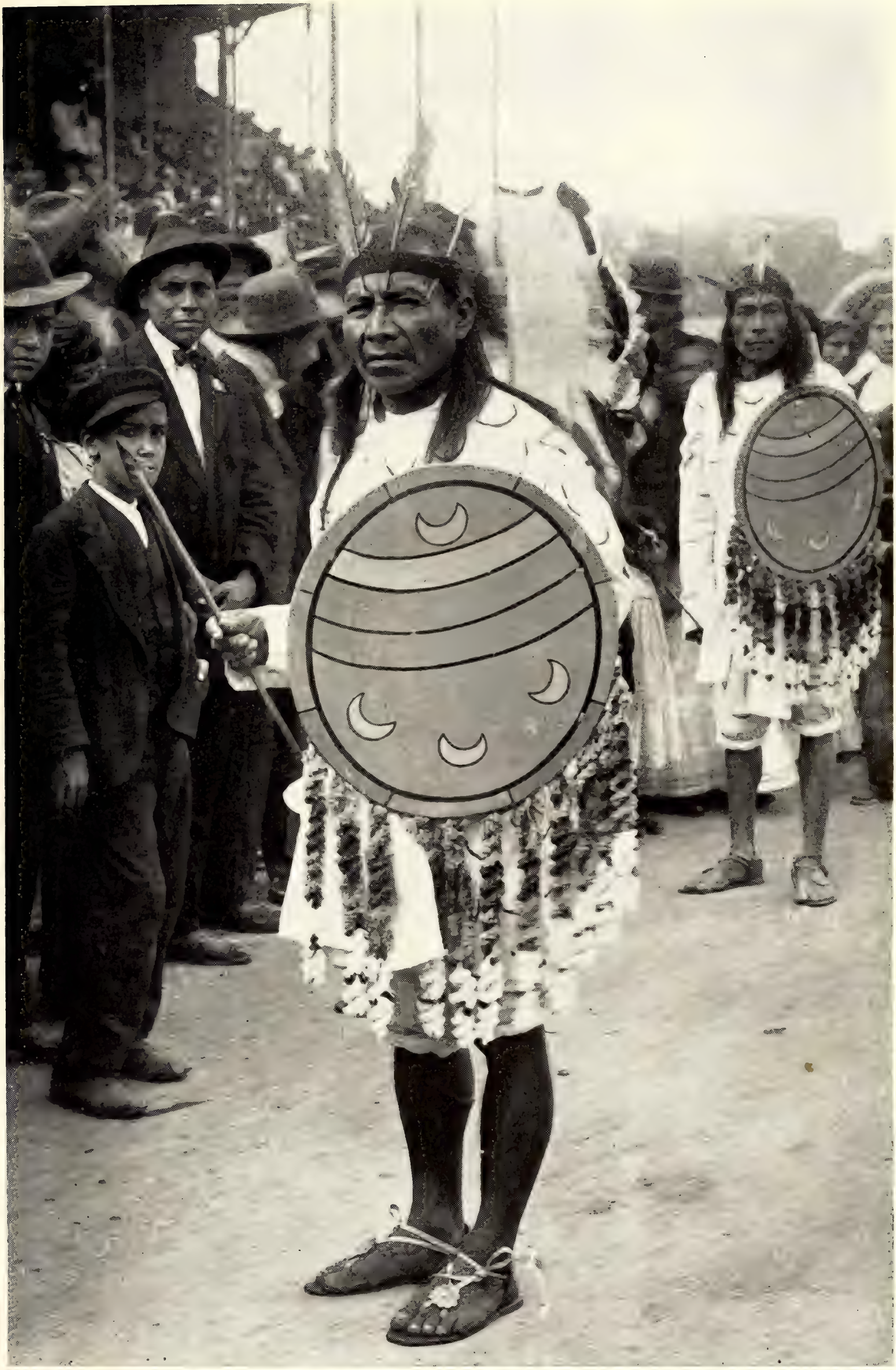
A passing Indian woman, barefoot and with uncovered head, a child slung in her "rebosa" over her shoulders, suggests intimate association with garlic, onions, and pulque, which is balanced by an atmosphere heavily laden with artificial perfumes, which are features of the toilet of milady on her promenade.

A speeding automobile diverts its course to avoid a drove of sleepy burros laden with lumber, feed, or pottery, or a lumbering traffic wagon moves side by side with lithe "cargadores" carrying on their backs or on litters household goods of every variety.

A gorgeously appointed funeral trolley car, conveying the remains of one whose family can afford this expense, may reach the burial place simultaneously with three or four peons, packing on their shoulders the body of a comrade in a plainly painted coffin, the use of which is rented and which will be returned after the body is given interment.

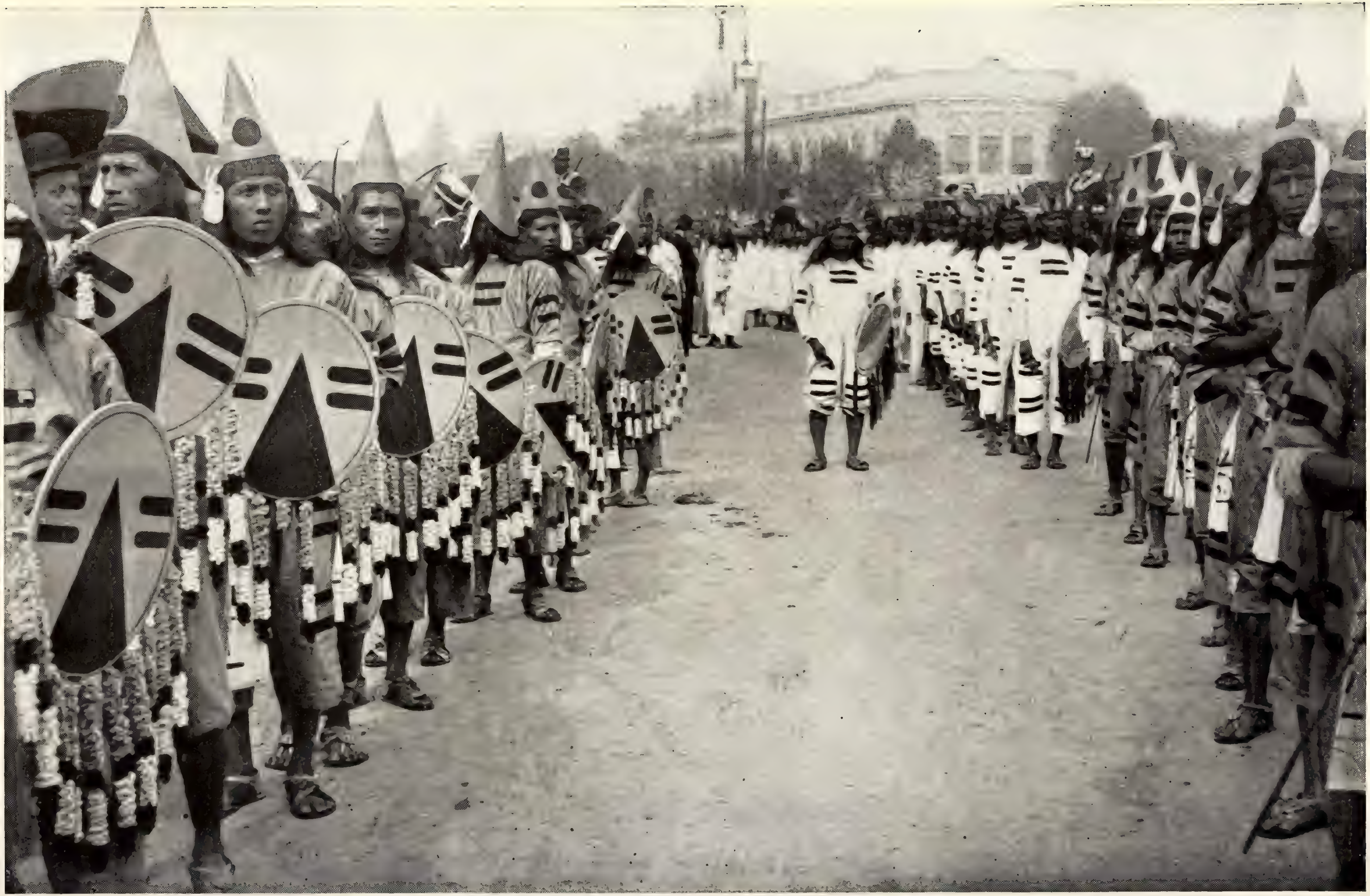
Riveters joining the skeleton steelwork of a great opera-house look down upon a building near by being altered, the workmen using scaffolding bound together with ropes in lieu of nails or spikes.

One-story and possibly single-room adobe houses plastered in colors adjoin large structures of elaborate architecture; industrial establishments are neighbors to handsome homes, through whose spacious doorways are had glimpses of beautiful patios adorned with flowers and fountains. The wide entrance of a "casa grande" sandwiched



CUITLAHUAC, A YOUNGER BROTHER OF MONTEZUMA, WHO SUCCEEDED THE LATTER AS SOVEREIGN

This and the following illustrations were features of the historical procession of Mexico's centennial celebration in September, 1910, the participants being, as far as possible, descendants of those they represented.



MEXICANO WARRIORS, AS REPRESENTED IN THE HISTORICAL PROCESSION OF THE CELEBRATION OF MEXICO'S CENTENNIAL OF INDEPENDENCE

The costumes and arms are similar to those of the Mexican soldiers who opposed the Spanish conqueror, Cortés, and it is probable that the between stores on the street level may give access to luxurious and richly appointed living apartments on the floors above. In one home a course dinner (and the number of courses is great) will be served with the best viands and all the equipments of wealth, while tortillas and frijoles are the staple food of the immediate neighbor.

The light from a single candle may dimly illuminate the smoky interior of an adobe home, while the street outside is ablaze with lights supplied by electric current generated at a modern hydroelectric plant, conveyed at high voltage for 95 miles to operate an excellent system of urban and suburban railroads and supply illumination.

The contrasts are not confined to the cities, but are also pronounced in the open or mountain country.

The "Camino Real" paralleling the railway brings into close association locomotives drawing trains of well-equipped passenger cars, the pack-mule, the heavily laden burro, the clumsy ox-cart with cotton-wood slabs for wheels, and the peon trotting along under burdens apparently out of proportion to his physique.

Far from rail or even wagon roads the whirr of a sewing machine may come from within a cane or mud hut, while the master of the house (if it can be so called) scratches the ground with a crude plow or threshes his grain by driving animals over it.

No extensive journey is necessary to pass from the humble home of a weaver, who with ancient hand-loom fabricates serapes of neat design from wool which he has carded, spun, and dyed by hand, to a splendidly equipped mill of many looms, operated by hydraulic or steam power.

In the sugar-growing country, wooden, stone, or copper rolls operated by animal power extract the saccharine matter from cane and the excess molasses is absorbed by a wad of mud, although a few miles distant an hacienda with the highest type of roller mills, vacuum pans, and centrifugals produces large quantities of sugar of a superior character.

The climate, too, has its extremes, for on the highland one seeks the warmth of the bed early, because of the chill night air, but finds the sunny side of the street too warm in midday. The lowlands have days of intense torrid heat, preceding others when a strong "norther" chills to the bone. Months of drought, during which little if any rain falls, are succeeded by intervals when rain may be expected for a part of every day, the precipitation being so heavy at times as to produce serious loss by freshet conditions.

LARGE ESTATES

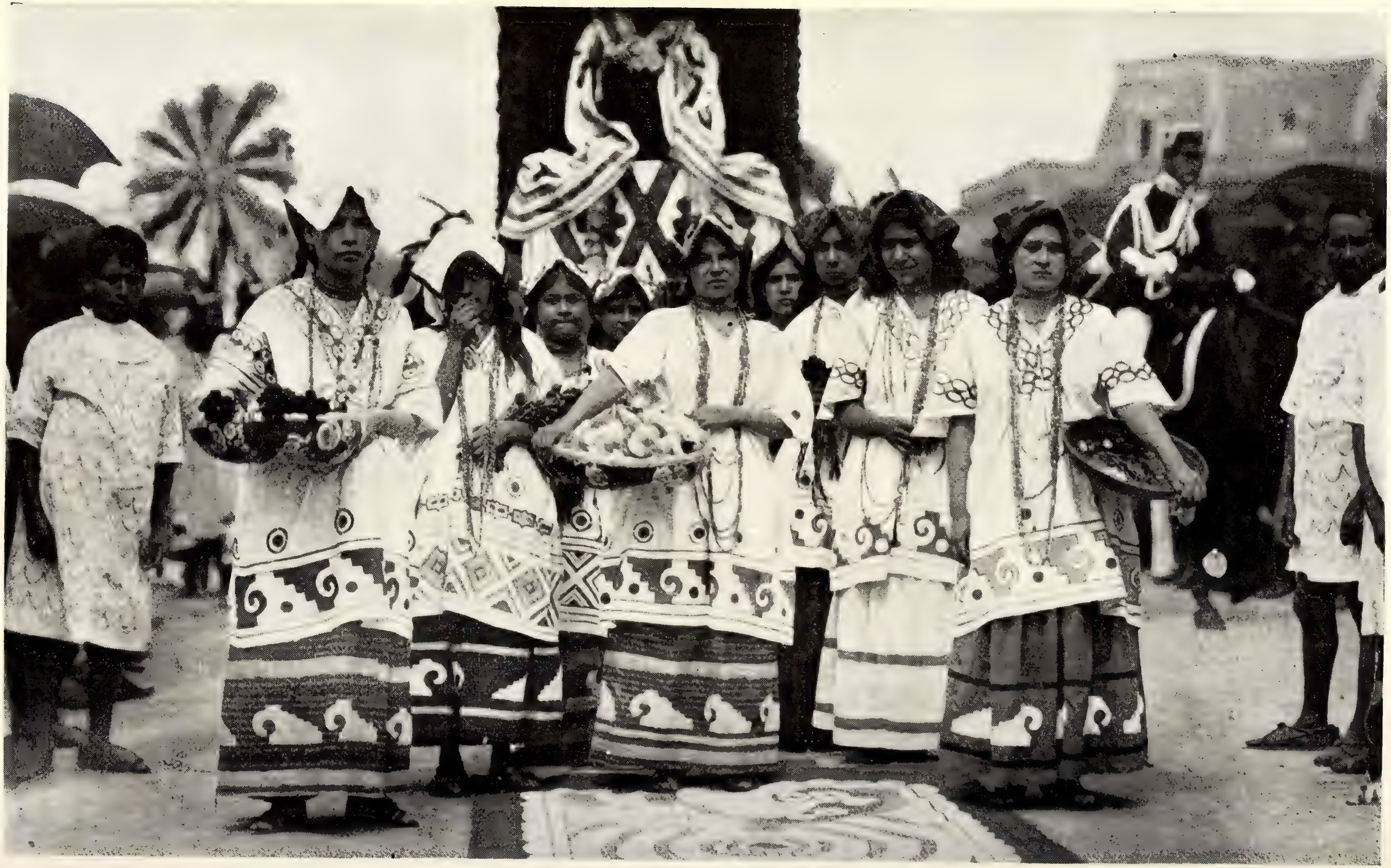
Among the problems disturbing Mexico are landed interests controlling enormous areas, some utilized chiefly for grazing or live stock, others for raising sugar-cane, aguave (for the production of pulque), henequen, rubber, etc.

In the sugar country large amounts of capital are invested in buildings to accommodate machinery, much of which is of high character, or for administration, and in many instances elaborate church structures are features of the haciendas. Heavy amounts of Mexican capital are invested in these large estates, in haciendas and industrial establishments; but the claim is made that relief from taxation on large unproductive areas retards Mexico's progress and places unnecessary burdens upon developed properties.

FOREIGN INVESTMENTS

Much of the railroad development, many of the better-equipped mines and large industries are to be credited to foreign expenditures more than to Mexican capital, the United States holding a leading position in these investments; but European countries and Canada have supplied liberal sums, the aggregate of foreign capital being reported as 1,000 million dollars.

In Mexico City there are seven banks chartered by the government, having capitals totaling 35 million dollars, and in most of the States are similar institutions with the privilege of issuing currency that passes at par on a silver basis, which is 50 per cent of gold value.



DNA. MARINA (MALINTZIN) AND HER RETINUE OF INDIAN LADIES

Marina, the Indian guide and mistress of Cortés, is a prominent personage in all histories of the Conquest of Mexico. This group illustrates the costumes prevailing in Mexico 400 years ago, and formed part of the historical pageant in celebration of the centennial of Mexico's independence.

Numerous private banks are scattered throughout the country, and the failure of several in late years has brought such drastic penalties upon the guilty parties as to discourage irresponsible enterprises.

The national debt of Mexico amounts to 218 million dollars. A part, bearing 5 per cent interest, has been quoted at par; the balance, paying 3 per cent, commands 70 to 75 cents on the dollar. Some of the 5 per cent bonds have been lately replaced by others yielding 4 per cent.

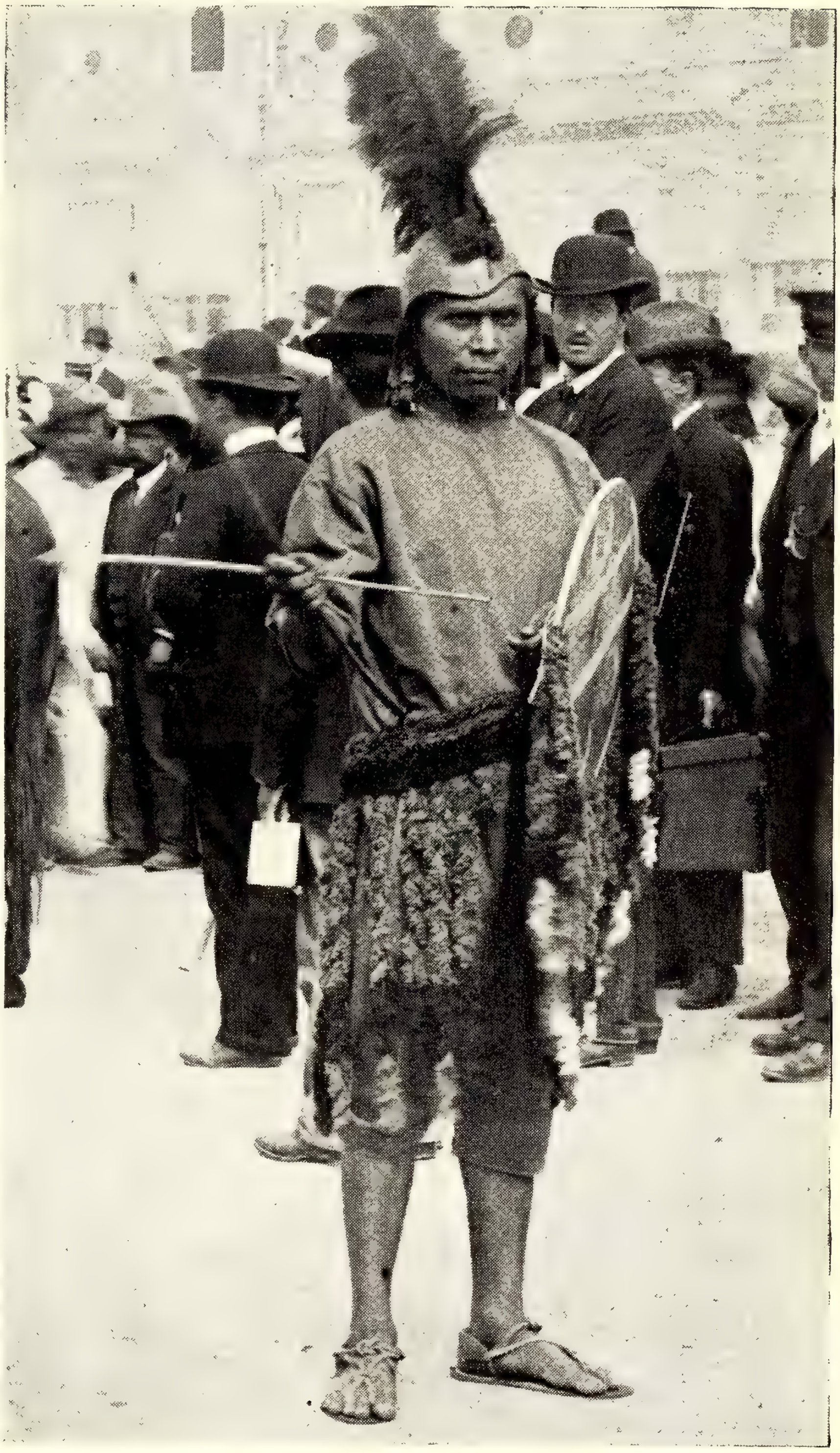
The government is also responsible for the bonds covering the railroad merger, by which Mexico controls the leading transportation systems, and for a mortgage bank operating under charter, which has for its function financing irrigation and agricultural development.

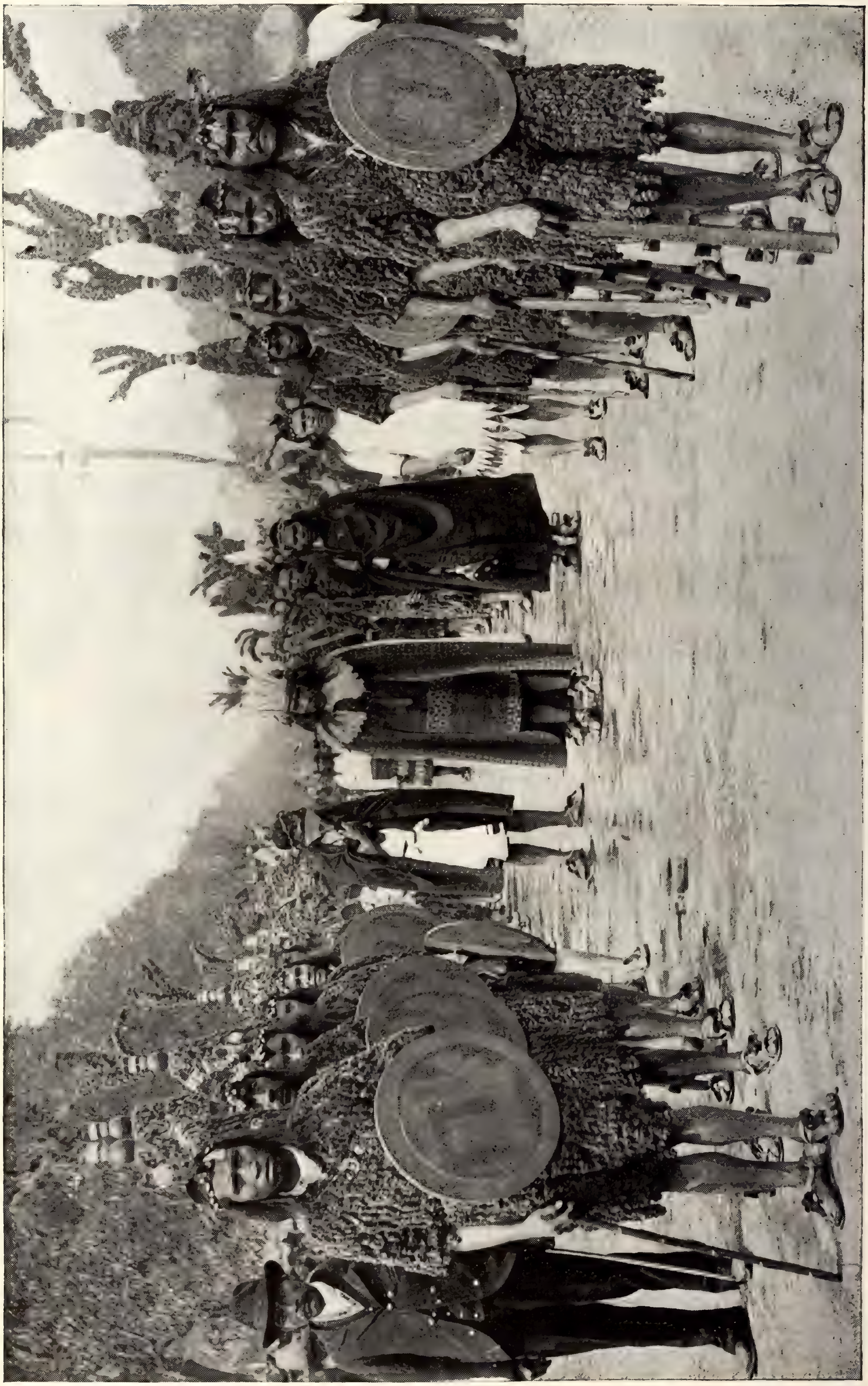
In the capital there is also a chartered bank, "Hipotecario," which loans money on improved properties at 9 per cent and issues against these 6 per cent bonds, the mortgages being automatically satisfied at the expiration of 25 years—a method somewhat akin to American building and loan associations.

PRESIDENT DIAZ

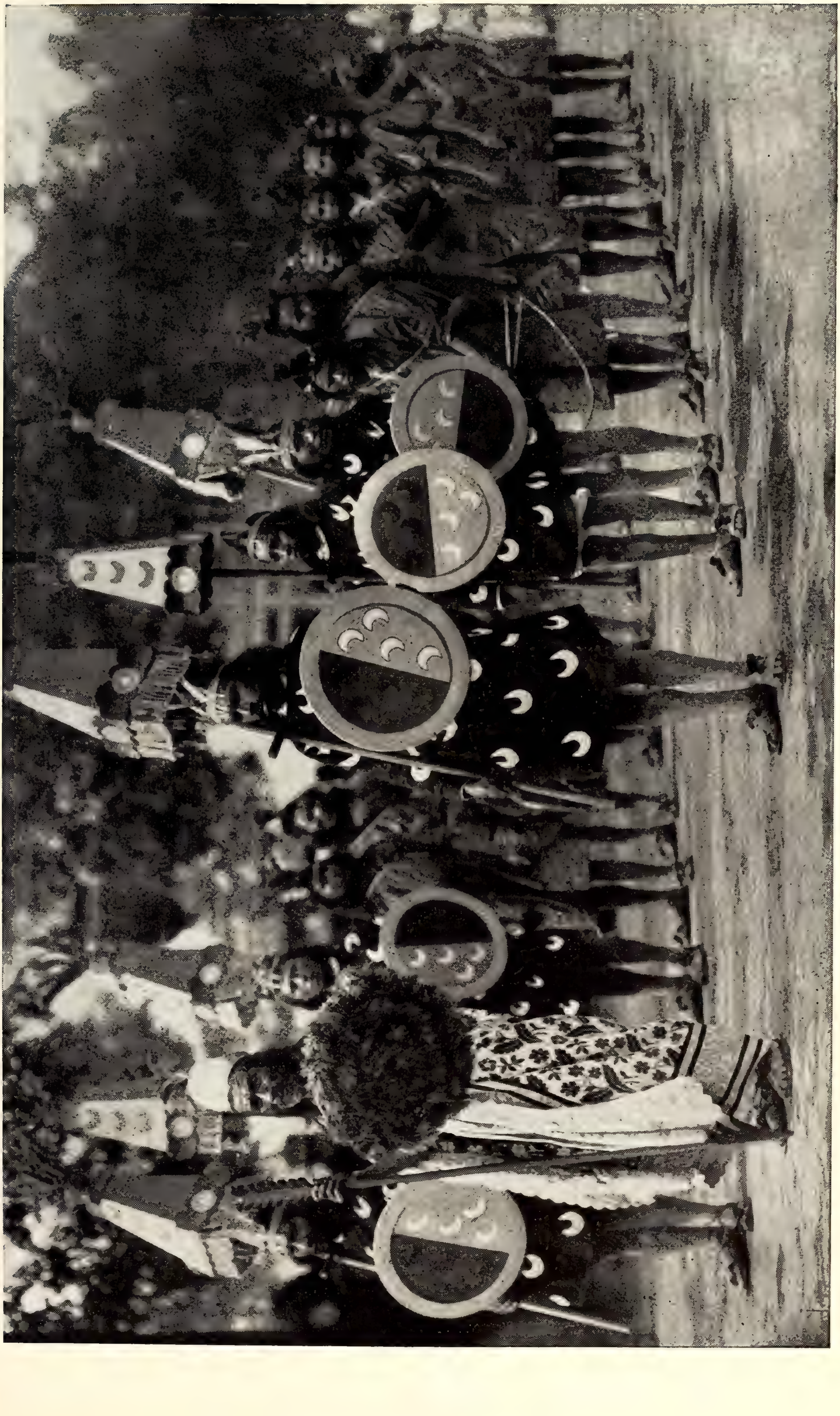
Since our own Centennial, in 1876, Mexico has been peaceful and progressive; transportation, commerce, industries, and education have advanced. From a nation on the verge of bankruptcy it has risen to one whose credit is excellent, and all well-wishers of the country hope that the many evidences of progress, for which the execution if not the initiative are credited to General Porfirio Diaz, will not be retarded by protracted internal dissensions or by extraneous complications.

Unfortunately many of those who write of the Mexican President portray him either as an angel or a devil. The struggles of an orphaned Mixtecan boy and the subsequent life of a soldier are not apt to develop shoulder-blades into angel wings, especially where much of this life was spent in guerrilla warfare in rugged mountain country, accompanied by great hardship and privation. Neither are the recollections of capture, imprisonments, escapes, wounds, and torture calculated to soften; but these experiences have molded a character bold, decisive, dominant, which, exercised for the good of his country, means progress.


CAPTAIN OF MEXICANO WARRIORS (SEE P. 502)



TLAXCALAN WARRIORS, SHOWING CACAMA, KING OF TEXCOCO, WITH CROWN OF FEATHERS



PRIESTS OF THE MEXICANO WARRIORS

The costumes, arms, and accessories were made as near as possible in harmony with those used 400 years ago

Reared to military discipline, his punishments are severe, and the enemies he has made are bitter in their opposition; but the mass of the people, while fearing his wrath, honor him for what his strong will, recognized ability, and patriotism have achieved for Mexico.

Those who see only evil in all that Diaz does and by reason of autocratic conditions place upon him the responsibility for all acts of subordinates, do injustice to Mexico and to its President.

Opportunity to judge President Diaz at close range, in his executive office in the National Palace and in his Chapultepec home, presented to the writer a manly man of strong personality and quick perception, prompt to act, courteous to callers, and evidently ready to give attention to suggestions which appeared to be for the ultimate good of his native land.

VALLEY OF MEXICO

The broad azotea of the castle of Chapultepec overlooks the City of Mexico, with its multitudinous flat-roof buildings accentuating numerous towers or domes of cathedrals and churches, and the few high buildings of modern construction. The imposing groves of ancient cypress trees in the adjacent park, Mexico's oldest inhabitants, have lived through many stirring epochs, for the ground occupied by this city has been stained with human blood as have few areas of equal extent. This was the site of Tenochtitlan, generally accredited to the Toltecs, a people who preceded the Aztecs; also the scene of the reputed magnificence of Montezuma's dynasty, described as a populous municipality, with excellent laws, established courts, able craftsmen, and evidences of a civilization long antedating the knowledge of our own portion of the continent—a civilization in strange contrast with human sacrifices on the Teocalli and cannibalism accredited to the Aztecs.

It was here that by a combination of skill, diplomacy, generalship, and fanaticism Cortés, with a relatively insignificant force, overpowered numbers and superstition and laid waste the Aztec capital.

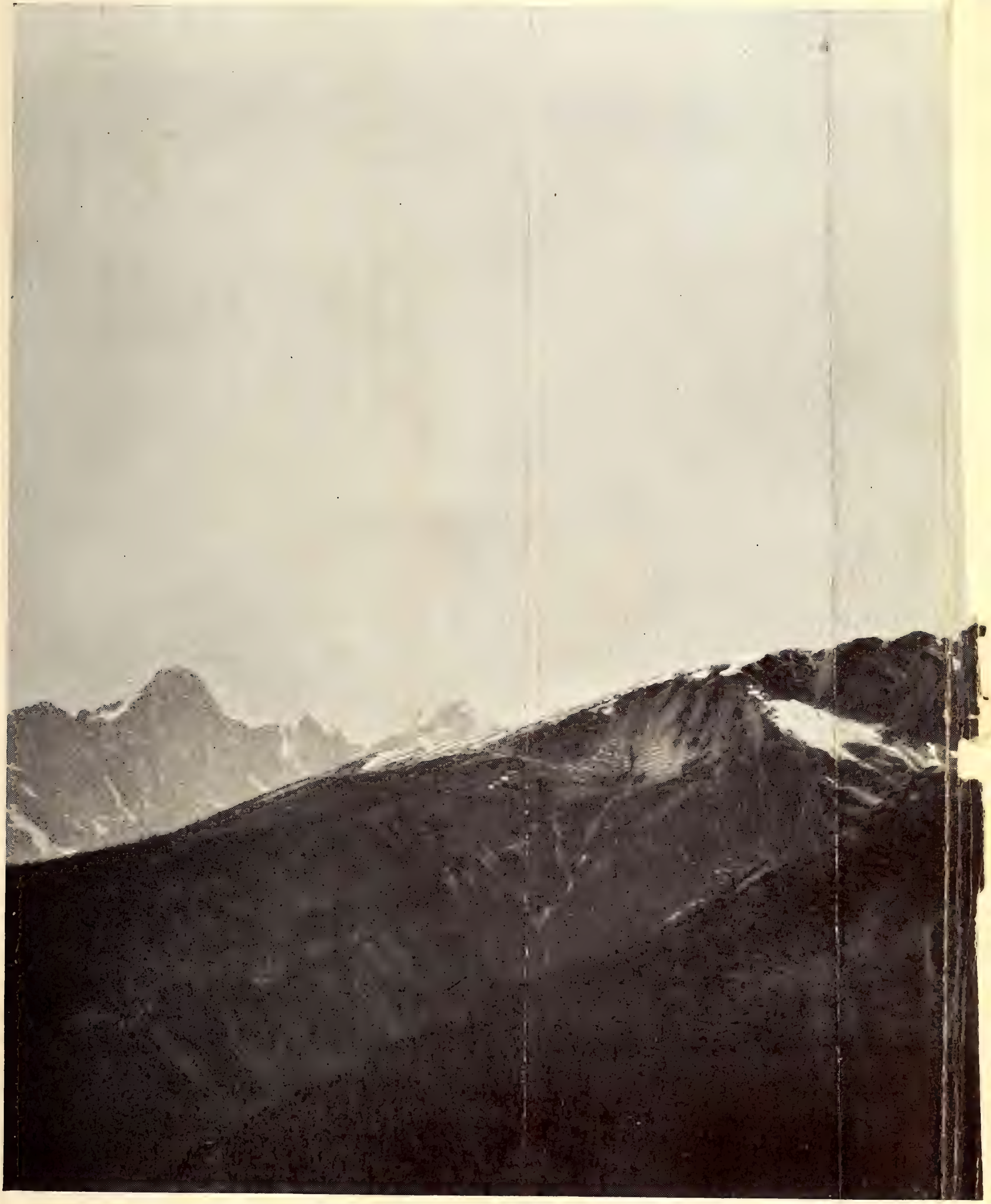
The excesses, accompanied by loss of life, subsequently committed by the Inquisition in the name of religion for the aggrandizement of Spain, and in part glossed by the excellent structures which were built, need not be recounted.

But history tells of the numerous political convulsions which were initiated in or disturbed the city in the efforts of various aspirants to be leaders of the new republic, troops besieging or ravaging as one after another sought to establish himself as President, Emperor, Dictator. The investment by the United States troops, the capture of Chapultepec, and the fall of the capital; the occupancy of the city by the European allies, when Maximilian was enthroned, and its subsequent recapture by the Mexicans, aid in presenting a varied but sanguinary historical vista.

The protecting rim of mountains encircling the valley of Mexico; the snowy crests of Popocatepetl and Ixtaccihuatl; the quiet waters of the lakes, materially reduced in area by a comprehensive drainage system extending for 50 miles; the cultivated fields and the surrounding hamlets, each with its church; the lines of smoke from industrial chimneys and locomotives, combine to suggest peace and prosperity, which all hope may continue in our neighbor, Mexico.

Supplement to the National Geographic Magazine, Washington, D. C., June, 1911. Gilbert H. Grosvenor,

Van Horn Range, Summits above 9500 Ft.



Panoramic View from the west side of Burgess Pass, 3280 feet

From a photograph by Charles D. Walcott, Secretary of the Smithsonian

pplement to the National Geographic Magazine, Washington, D. C., June, 1911. Gilbert H. Grosvenor, [illegible]or

Panoramic View from the west side of Burgess Pass, 3280 feet above Field, British Columbia, in the Canadian Rockies

From a photograph by Charles D. Walcott, Secretary of the Smithsonian Institution. Copyright by National Geographic Society

VOL. XXII, No. 6 ON JUNE, 1911

THE NATIONAL GEOGRAPHIC MAGAZINE

A GEOLOGIST'S PARADISE

By Charles D. Walcott

Secretary of the Smithsonian Institution

NATURE has a habit of placing some of her most attractive treasures in places where the average man hesitates to look for them. Twenty-five years ago rumors came of a wonderful find of glaciers, forests, mountain peaks, and lakes along the line of the rugged pass through which the Canadian Pacific Railway was building.

A geological reconnaissance by Sir George M. Dawson, of the Canadian Geological Survey, outlined some of the broader geological features, and a somewhat closer study by Mr. R. G. McConnell in 1886 resulted in a more accurate description of the thousands of feet in thickness of sandstone, shale, and limestone that had been arched and broken before being dissected and laid to view by the agents of erosion which formed the canyons, cliffs, and mountains by removing grain by grain or by chemical solution the material that formerly occupied or surrounded them.

A young American, Walter Wilcox, taking his surveying instruments and camera, spent summer after summer sketching maps and photographing the scenery, and in 1896 he published the first of several beautiful volumes on "Camping in the Canadian Rockies." Later, with the development of the kodak, thousands of pictures were taken by tourists who had little thought of the geological treasures lying all about.

The study of the glaciers was begun early by an American, George Vaux, of Philadelphia, assisted by his sister Mary, and later an expedition sent out by the Smithsonian Institution under the leadership of William H. Sherzer, of the University of Michigan, resulted in the publication in 1907 of a memoir describing and illustrating many of the glaciers.

During the past three years an expedition from the Smithsonian has been making an examination of the four miles or more in thickness of bedded rocks forming the main range of the Rocky Mountains that has been pushed eastward by the great mass of the Selkirk ranges to the west. It is a curious and instructive feature of the geology that the strata of the Rockies, although crowded eastward and thrust out over the later rocks of the plains of Alberta, have not suffered nearly as much dislocation, injury, and alteration as the apparently more massive bedded rocks of the Selkirks. The latter are crumpled, broken, and altered in about the same manner as large blocks of brittle paper would be if subjected to side pressure in a hydraulic press.

CAMP CONTENTMENT MEADOW, ABOVE LAKE O'HARA, AT FOOT OF MOUNT SCHAFFER Photo by Charles D. Walcot

MOUNTAIN - BUILDING ON A GRAND SCALE

The study of the arched block of strata 16,000 feet or more in thickness from which the picturesque and impressive mountains and canyons have been carved has resulted in the discovery that the rocks in which the great Bow Valley is excavated form a part of the North American continental beds that were deposited in great fresh-water lakes before the waters of the ocean swept over the continent and began their task of depositing the 12,000 feet or more in thickness of rocks of Cambrian age that now contain the remains of the marine life of that period.

As the study of the formations developed it was found that in the eastward thrusting of the rocks massive limestones were often crushed and ground into fragments; in other places the thinner beds for 100 feet or more would be folded and crumbled between huge masses of even-bedded limestone that showed no traces of disturbance. In other places a series of beds, 1,000 feet or more in thickness, met some obstacle which they could not crush or surmount, and were driven upward at almost right angles, forming series of sharp, ragged ridges. On the east side of the

Lower Yoho Valley the limestones of Mount Ogden are lying nearly level, but on the eastern slope above Sherbrooke Lake Canyon the same beds are turned down at right angles and disappear beneath the canyon bottom. Everywhere the keen eye of the geologist will find evidence of mountain-building on a grand scale.

The panoramic photograph, taken by the author from Burgess Pass, 3,000 feet above Field, and published as a Supplement to this number of the NATIONAL GEOGRAPHIC MAGAZINE, shows at a glance over 9,000 feet in thickness of bedded rocks, 6,000 feet of it in an almost sheer cliff in the mass of Mount Stephen. Many thousand feet more may be seen to the westward in Mount Denis and in Mount Vaux. From Mount Stephen the eye follows to the left across the great canyon of the Kicking Horse River to the summit of Mount Field, two miles away, where the same limestone and shale beds carrying the same fossils indicate that thousands of feet in thickness and many million cubic yards of hard rock have been removed by erosion from between the two mountains, Stephen and Field. From Mount Field a gentle slope carries the same beds northward through Mount Wapta, where they undulate across the President Range and plunge to the westward beneath the corrugated and more readily broken Ordovician rocks of the Van Horne Range.

EARLY MARINE LIFE

All of the Cambrian rocks were deposited in waters teeming with marine invertebrate life. As far as now known, this was before the day of fish or of any other vertebrate animal; land plants and even marine vegetable life were almost unrepresented. Other animals of the sea, however, existed in great profusion, and here and there conditions were so favorable for their burial in the mud and sand of the Cambrian sea that they were preserved unbroken, and throughout all the processes of rock-making and mountain-building they have escaped destruction.

In one of these favorable places the most delicate of organisms, like the jellyfish, have been exquisitely preserved and we have crustaceans of many varieties. Among these many preserve the most delicate branchiæ and appendages, and one can hardly realize that they were buried in the mud 15 to 20 million years ago and have remained undisturbed while several miles of thickness of sediment were deposited over them, changed into rock, elevated into mountain masses, and later eroded into the present mountains and canyons.

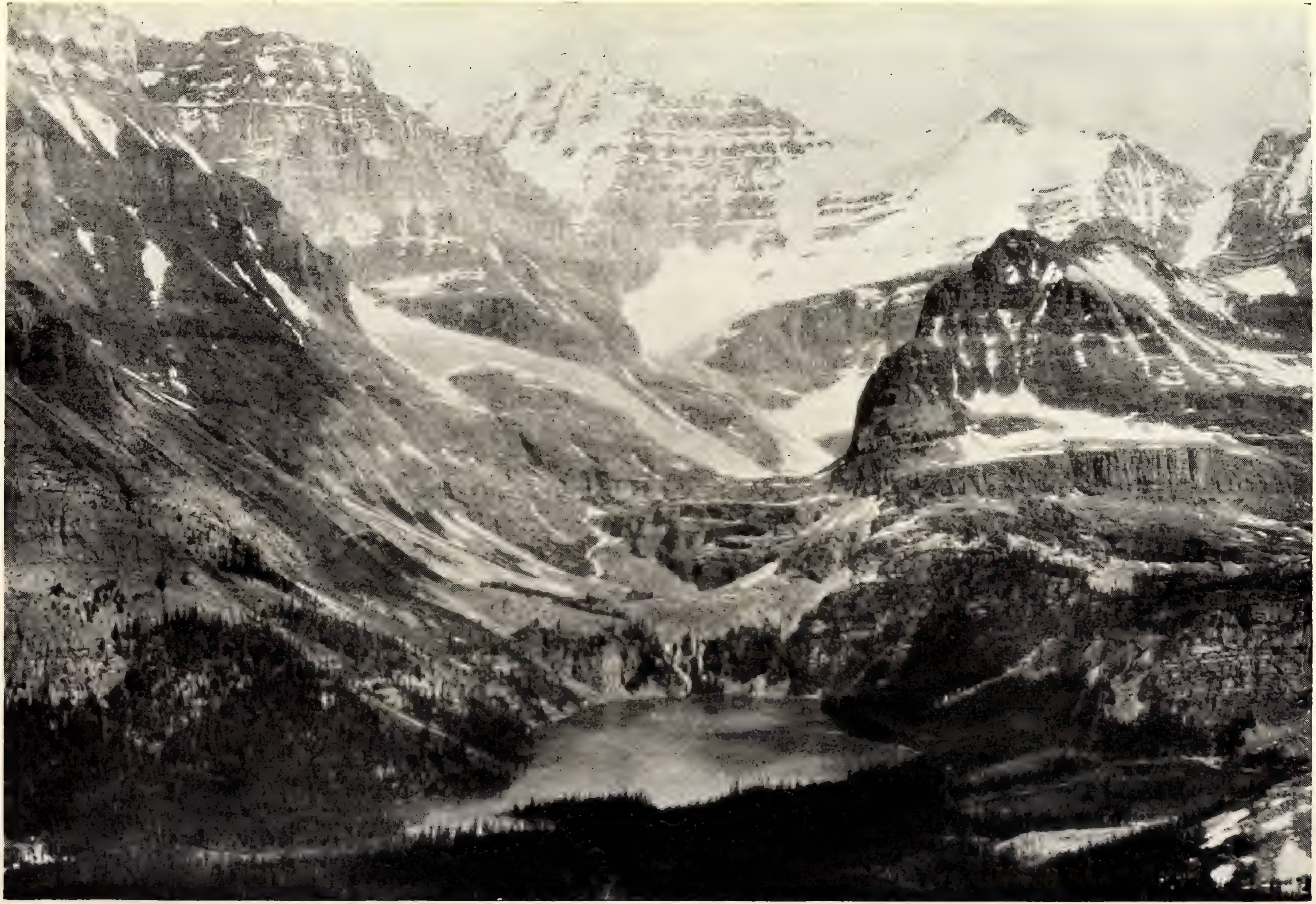
We have long considered that the trilobite (page 516) was the most highly developed animal in the Cambrian time, but last summer a crustacean was found by the author in the fossil bed near Mount Wapta that was the king of the animal world in its day (page 517). That it was prepared to assert its right to the control of the Cambrian sea is shown by the claws with which it was armed.

To the geologist interested in the volcanic rocks a great field is waiting in the Selkirks to the west, and for generations to come there will be unsolved problems for the special student in this great region of mountains, glaciers, and rivers.

SUMMARY OF GEOLOGIC FORMATIONS

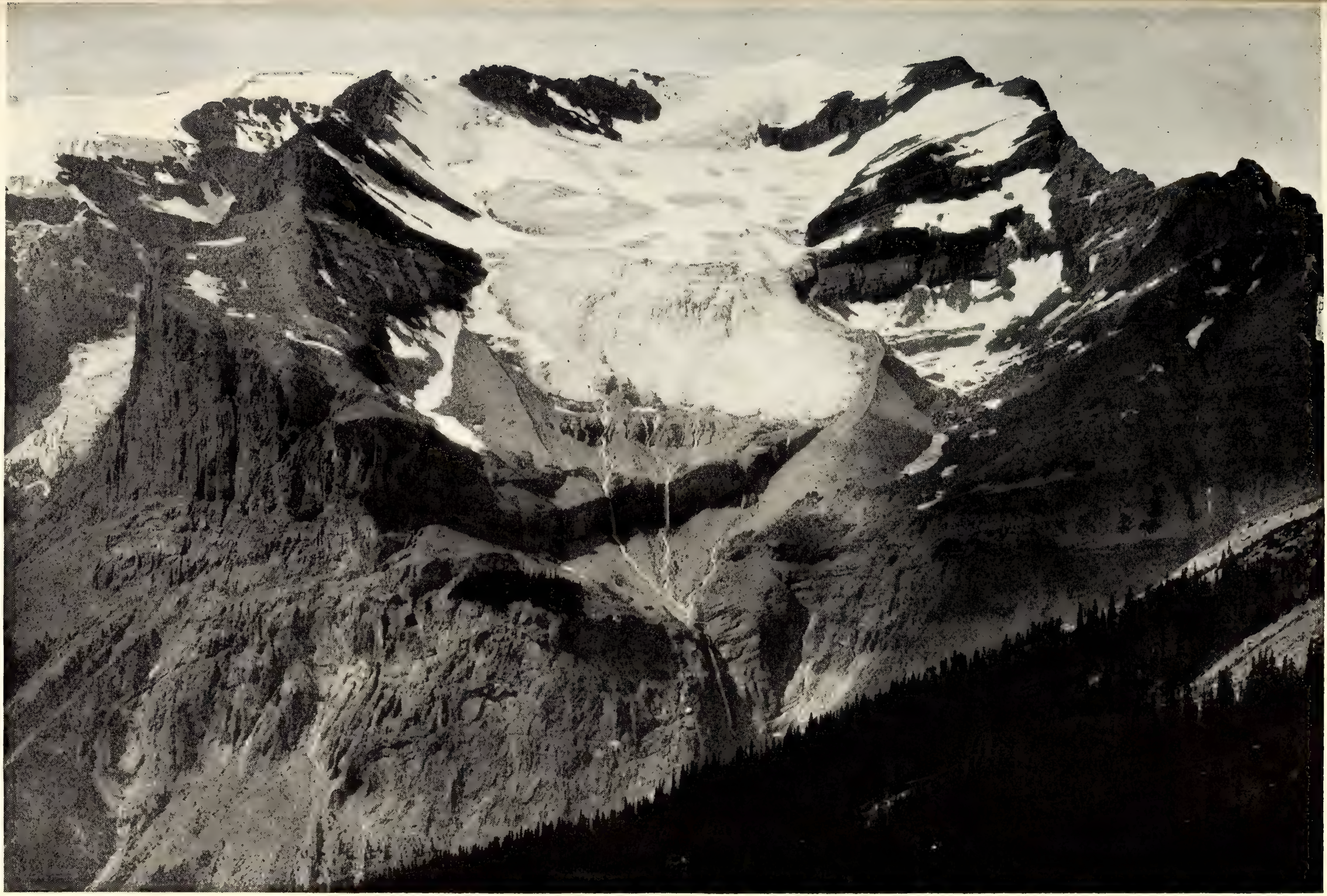
In the long panoramic view the rocks seen in the distance, forming Mount Balfour, belong to the Sherbrooke formation of the Upper Cambrian, or the most recent rocks of the Cambrian section. Beginning with these and going downward, the following formations are passed through:

UPPER CAMBRIAN	Feet
Sherbrooke formation (mainly limestones)	1,375
Paget formation (limestones and shales)	360
Bosworth formation (limestone and shale)	1,855+
Total Upper Cambrian	3,590+



LAKE O'HARA (6,664 FEET) RESTS IN A BOWL IN THE MOUNTAINS

From the lake to the top of Mount Lefroy 4,000 feet of Cambrian strata are seen in one unbroken section. Photo by Charles D. Walcott



VIEW OF THE PRESIDENT RANGE FROM A POINT ON THE TRAIL ON THE WEST SLOPE OF MOUNT WAPTA, 3½ MILES IN AN AIR LINE NORTH OF FIELD, ON THE CANADIAN PACIFIC RAILWAY, BRITISH COLUMBIA, CANADA

This view shows Emerald Glacier after a light snow-storm has whitened the ice. Note particularly the two lateral moraines formed of broken-up light gray limestone (see page 520). Photo by Charles D. Walcott

Photo by Charles D. Walcott

WAITING ON THE BURGESS TRAIL UNDER MOUNT WAPTA

MIDDLE CAMBRIAN	Feet
Eldon formation (siliceous and arenaceous limestones) 2,700 to	2,800
This is the formation that caps Mount Stephen and many of the higher mountains.	
Stephen formation (limestones and shale)	640
Cathedral formation (arenaceous limestones)	1,595
Total Middle Cambrian	4,963

LOWER CAMBRIAN	Feet
Mount Whyte formation (limestones and sandstones)	390
Saint Piran formation (sandy shales and sandstones)	2,705
Lake Louise formation (siliceous shale)	105
Fairview formation (sandstones)	1,324
Total Lower Cambrian	4,524

SUMMARY	Feet
Upper Cambrian	3,590+
Middle Cambrian	4,963
Lower Cambrian	4,524
Total thickness of Cambrian section	13,077+

Beneath the old Cambrian sea-beach now forming the base of the Fairview formation there is a great series of sandstones and sandy shales of quite a different character. These rocks formed the land area which was submerged by the Cambrian sea that wore them away more or less in its advance over the continent.

These older rocks are supposed, owing to their character and the absence of marine fossils, to have been deposited in fresh water. They are referred to a series called the Algonkian, and are divided into two formations:

	Feet
Hector formation (sandstones and shales—gray, black, greenish, purple in color) total thickness	1,302
Corral Creek formation (sandstones)	1,320

THE WASTING AWAY OF THE MOUNTAINS

The breaking down of the mountain summits by the action of rain, frost, and ice, so as to form strong pyramids and ridges, is constantly going on. This is

Photo by Charles D. Walcott

A COOL SEPTEMBER MORNING AT 7,000 FEET ABOVE SEA-LEVEL

well shown by the photograph of Mount Huber, on page 518.

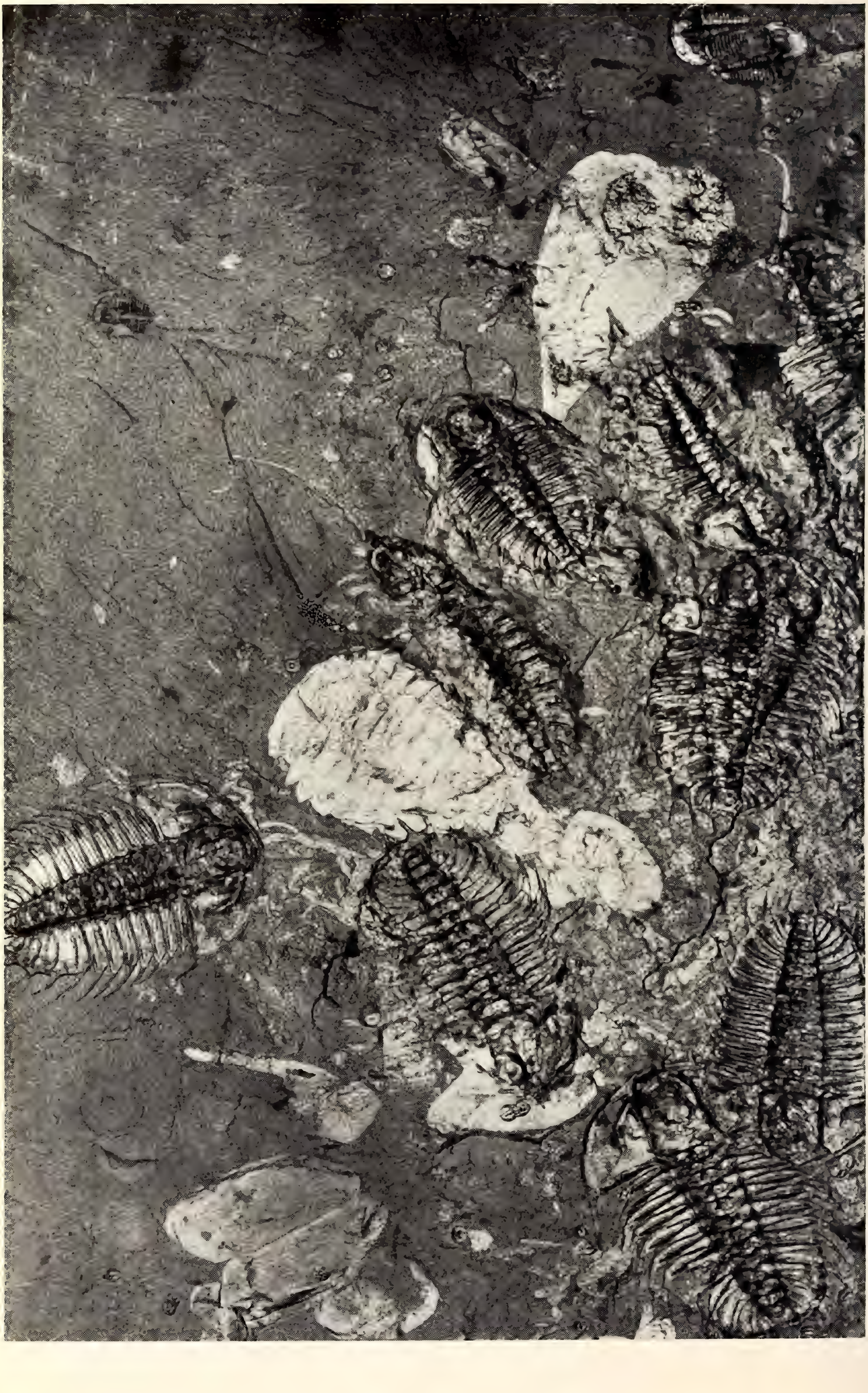
An illustration of a long summit ridge is given by Mount Daly, where every summer storm leaves a fresh coating of snow. I well recall stepping off the limestone onto the snow, thinking it hard and secure, and dropping in up to my armpits within a few feet of the rock. We were glad to paddle our way back and follow the rocky ridge for miles around to get back to camp.

Some of the deep canyons were filled up for 1,000 feet or more by dirt, gravel, and boulders washed down from the sides of the mountains, probably during the great Glacial period. Upon the withdrawal of the ice this accumulated material was rapidly cut away, but occasionally masses of it are left high on the sides of a mountain, and often most fantastic forms result from its erosion where the finer beds of gravel and clay are hardened and protected above by blocks of sandstone and limestone. One of the most noteworthy examples is that of the so-called Hoodoos, on the slope of Mount Vaux, 18 miles west of Field.

TAKING THE PHOTOGRAPHS

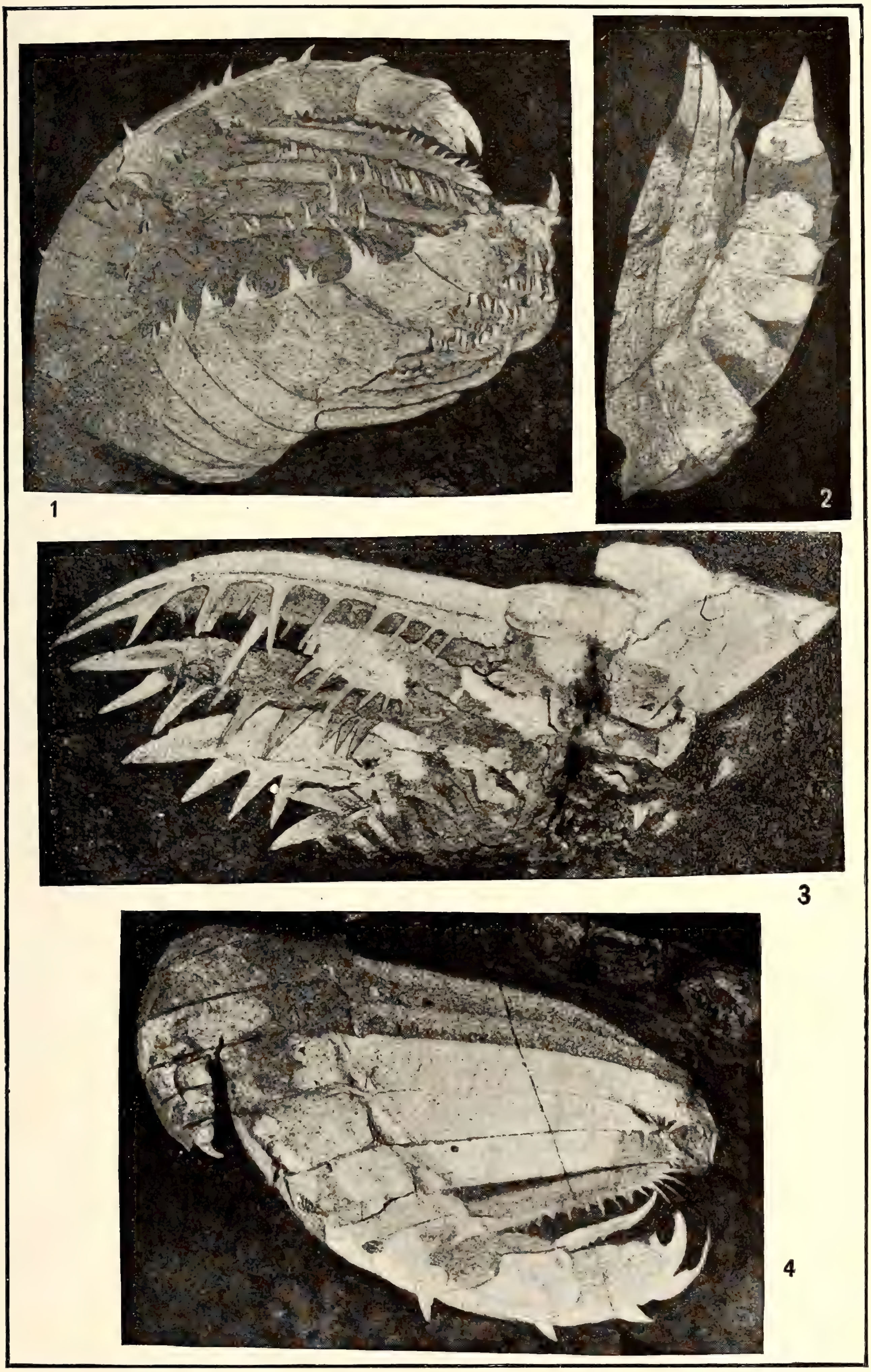
The panoramic photographs were taken with the Cirkut camera that is used by newspaper men and others for photographing processions and obtaining panoramic views of buildings, railway lines, etc. For use in the mountains several minor changes were made, so that the instrument could be used successfully under such adverse conditions as strong wind, hands and fingers numbed from cold, and often very insecure foundation for the tripod. As it is necessary to have absolute stability and the camera-bed level, the securing of perfect negatives is difficult.

The camera consists of the ordinary 6½ by 8½ outfit, with a panoramic attachment which is 10½ inches square by



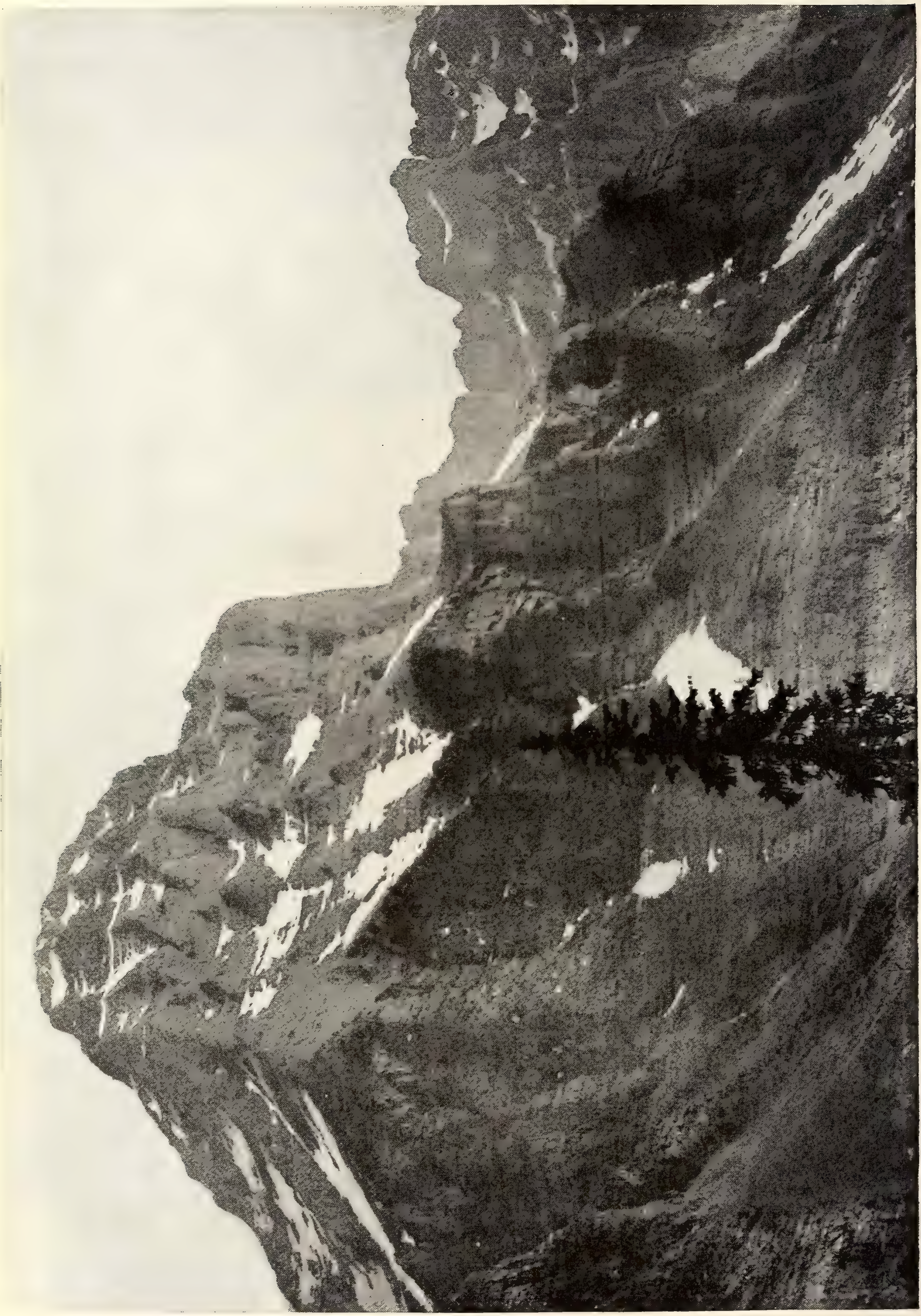
FRAGMENTS OF A COLONY OF MARINE ANIMALS ON A SLAB OF BLACK ROCK, WITH MANY TRILOBITES (DARK) AND SHELLS OF THE SIDNEY CRAB (LIGHT), WHOSE CLAWS ARE SHOWN ON PAGE 517

These creatures and other animals, like the delicate jelly-fish, have been preserved many millions of years while sediment several miles deep was deposited over them (see page 511). Photo by Thomas W. Smillie



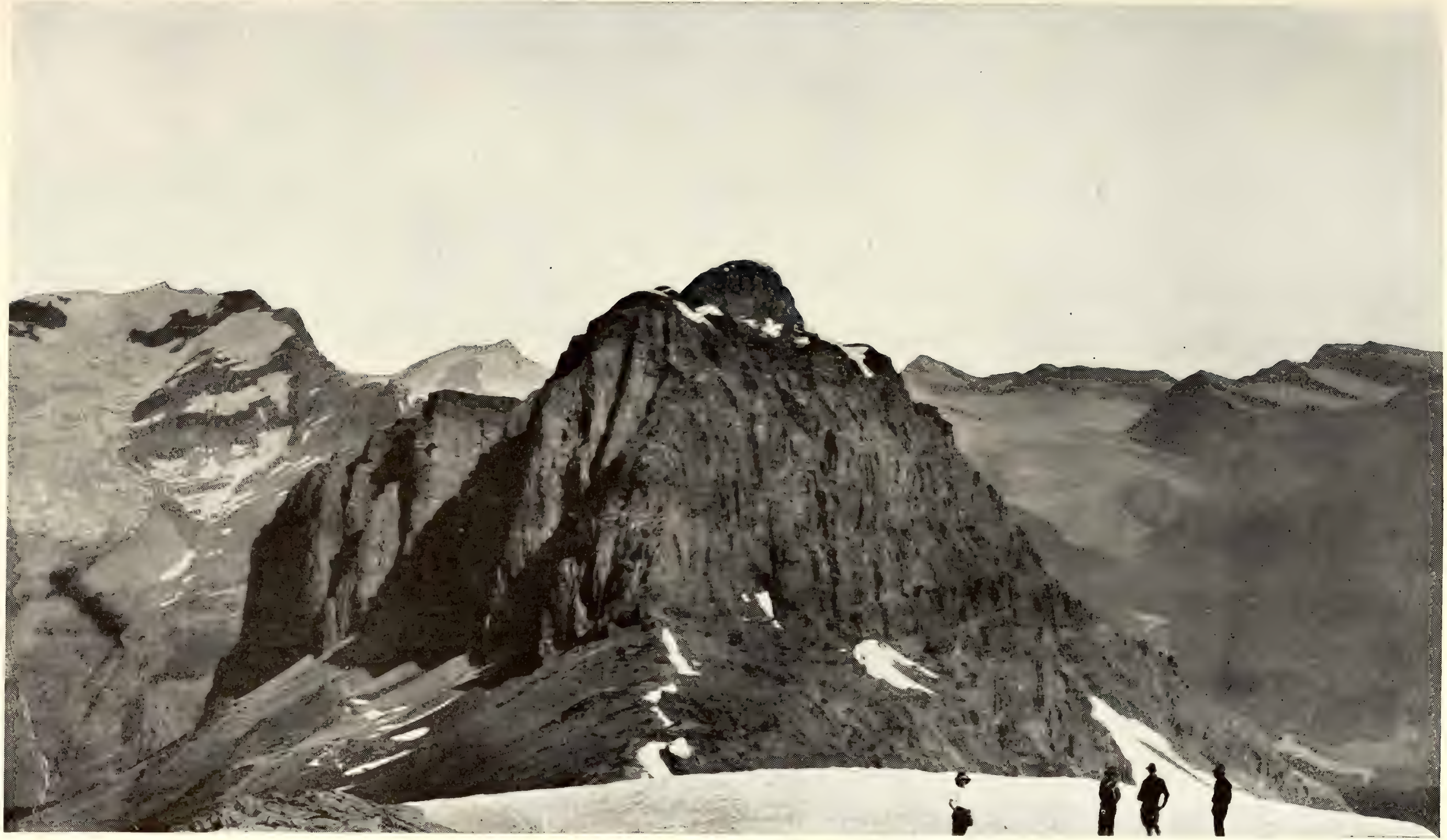
THE KING OF THE ANIMAL WORLD 15 MILLION YEARS AGO: DISCOVERED BY MR. WALCOTT

The spiny claws of the Middle Cambrian crustacean (*Sidneyia inexpectans*), shown as a light patch in the center of the figure on page 516 (see page 511)



VIEW OF MOUNT HUBER, SHOWING THE EROSION OF THE MASSIVE CAMBRIAN LIMESTONES ABOVE THE QUARTZITE SANDSTONES

View taken from a low ridge west of Lake O'Hara, six miles south of Hector, on the Canadian Pacific Railway, British Columbia, Canada



COOLING OFF AFTER A HARD CLIMB UP THROUGH THE LIMESTONES

Panoramic view, at 9,000 feet, of the south face of Mount Wapta from the summit of Mount Field, 4,600 feet above Field, on the Canadian Pacific Railway, British Columbia, Canada. Photo by Charles D. Walcott

Photo by Sidney S. Walcott

THE AUTHOR READY TO TAKE A PANORAMIC VIEW FROM SUMMIT OF MOUNT FIELD

4 inches in thickness. When the latter is used the tripod head is a 12-inch graduated circle with the revolving bed above. A ratchet, driven by springs, moves the camera around the circle, the speed being governed by fans. Our lens is a Bausch and Lomb Zeiss Protar, Series VII.

The long panoramic view had an exposure of one-tenth of a second over each part of the film. The film moves past a vertical half-inch aperture from right to left as the camera is revolving from left to right. With this instrument a view can be taken 8½ inches in height and of any desired length up to 10 feet. Two persons can readily carry the outfit anywhere that one can ordinarily climb. Under unusually difficult conditions the camera can be drawn up by a rope.

Often in the Canadian Rockies days will pass in which the atmospheric conditions are unfavorable for an extended view—dust blown in from the plains, smoke from forest fires, or the indefinite summer haze and cloudy weather interfering. The best conditions usually occur just after a heavy storm of either snow or rain has cleared the air.

One really great panoramic view and a half dozen fine smaller views is a successful season with the camera when it is used as an adjunct to hammer and compass in geologic work.

From the vicinity of the Burgess Pass camp the views were most beautiful and varied, and changed from hour to hour during the day and from day to day with the varying atmospheric conditions. Emerald Glacier, directly facing camp (page 513), was always attractive, whether in the bright sunlight, the gray light of early morning, the shadows of sunset, or when snow and fog were sweeping over the range, giving only now and then a glimpse of the ice and cliffs. The light-colored moraines on either side of its foot and the dark rocks afforded a beautiful setting for the glacier. Across the Yoho Pass the cliff of Mount Wapta stood in bold relief, with a steep slope of broken rock on the western side and a huge bank of snow on the eastern side of its south ridge.

Rising back of camp was the beautiful cliff of Mount Burgess, a favorite haunt of the mountain goat. At its eastern foot on the narrow ridge is the point where the great panoramic view was taken. Far below and almost at the foot of the great cliff is Emerald Lake, a spot famous for its scenic beauty. Our camp in the forest just below the ridge was visited quite frequently in September by heavy snow squalls that gave a welcome opportunity for a day's rest, reading, and cleaning up.

Our camp at Lake O'Hara was in a beautiful mountain meadow at the foot of Mount Schaffer. Morning and evening the views of the surrounding mountains were most inspiring. At this elevation (7,000 feet) snow squalls were not infrequent on the higher summits above, and on July 17 snow fell at the camp most of the day. From a slope of Mount Odaray, Lake O'Hara, resting like an emerald in a bowl of mountains (see page 512), reflected the glaciers of Mounts Lefroy and Hungabee.

Camping in the Canadian Rockies is a relatively simple affair if one is accustomed to going about with saddle and pack animals for conveyance. It is not difficult to obtain good camp outfits with horses and men, and much of the most beautiful scenery can be visited without riding on a trail or leaving wagon roads. Firewood and good water are well distributed and grass for the horses usually abundant.

OUR MOUNTAIN PANORAMA

NO ONE would be more surprised and delighted with Mr. Walcott's beautiful panoramic view, which is published as a Supplement to this number, than the American scientist whose discoveries gave a practical value to Daguerre's invention of photography, and the 100th anniversary of whose birth was celebrated last month. It is only 72 years since John William Draper in New York took the first photograph of a human face, but the progress in the photographic art since then is amazing.

Mr. Walcott's panorama is the most marvelous mountain view that has ever been published, and is remarkable not only for its exceeding beauty, but also because of the many lessons in geography learned by studying it.

Readers of this Magazine who have attempted to take photographs in high altitudes can appreciate the combination of patience and skill required to secure a panorama like our Supplement. Weeks usually elapse before the weather is favorable, and then the slightest error of judgment may make the exposure a complete failure.

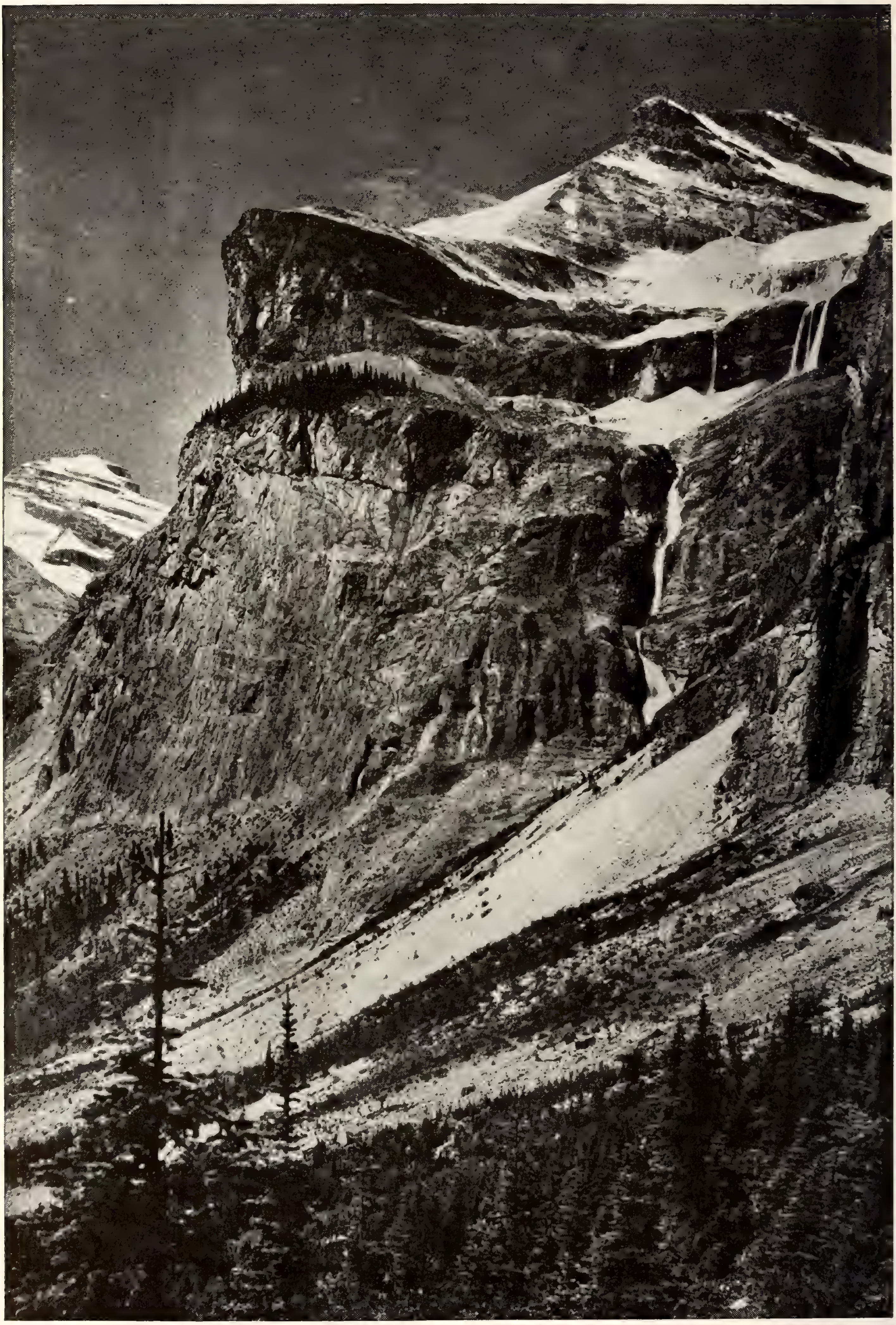
Perhaps equally difficult is the engraving, printing, and handling of 100,000 copies of the 9-foot picture. For the success of this part of the publication the NATIONAL GEOGRAPHIC MAGAZINE takes pleasure in acknowledging its indebtedness to the Matthews-Northrup Works, of Buffalo.

A few copies of the panorama have been printed on heavy art mat paper suitable for framing, and may be obtained at the office of the National Geographic Society at 50 cents per copy.

SCENES IN THE CANADIAN ROCKIES

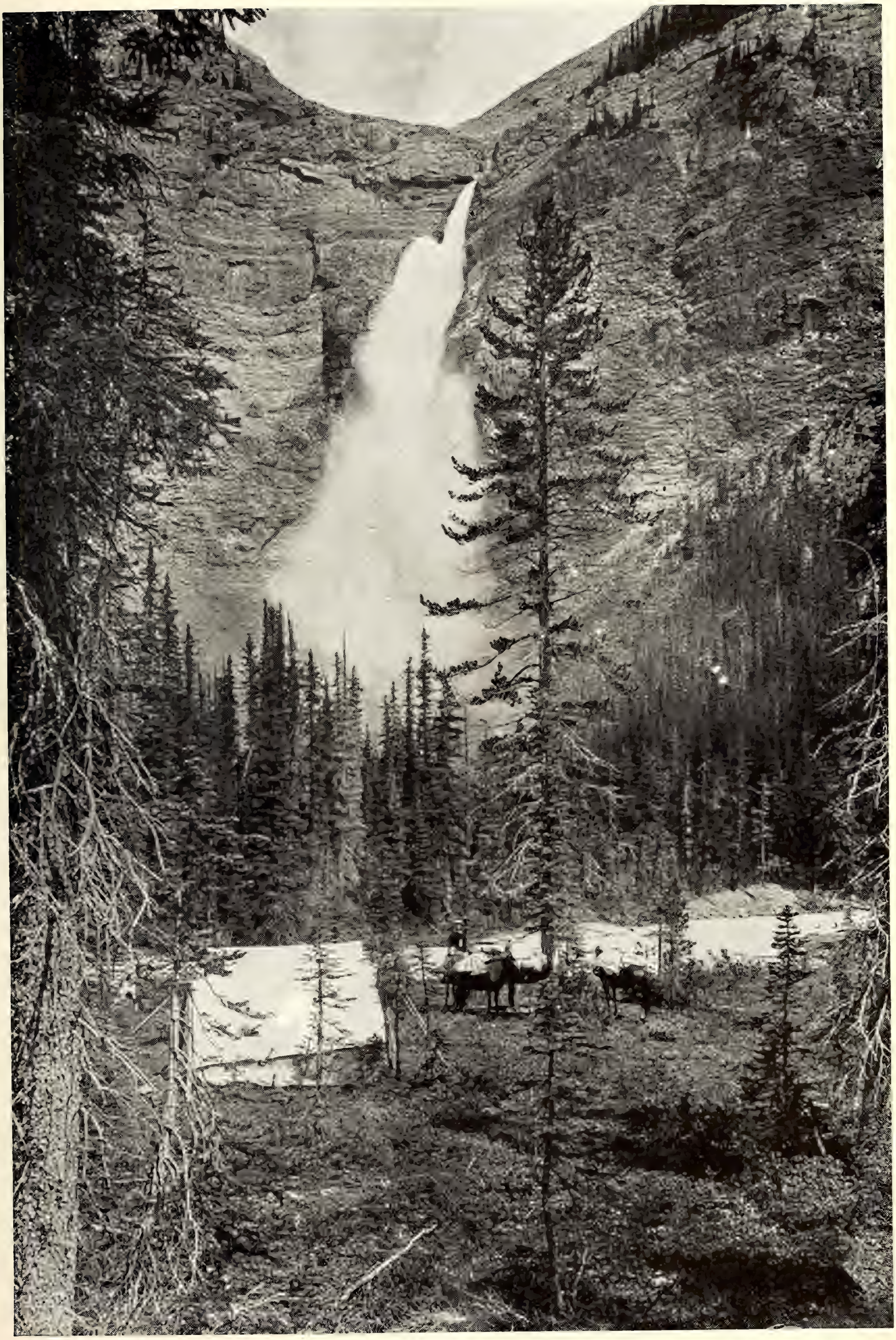
THE scenes in the Canadian Rockies, published on pages 522 to 536, are all from photographs by Rev. George Kinney, of Keremeos, B. C., Canada, who, with his companion, Duncan Phillips, has the distinction of being the first to ascend to the summit of Mount Robson, the highest mountain yet discovered in the Canadian Rockies.

Mount Robson is situated in the heart of the Rockies, some 50 or more miles north of Yellowhead Pass and hundreds of miles from civilization. The mountain can be reached only by pack-train after long weeks of strenuous endeavor through trackless forests and muskeg.



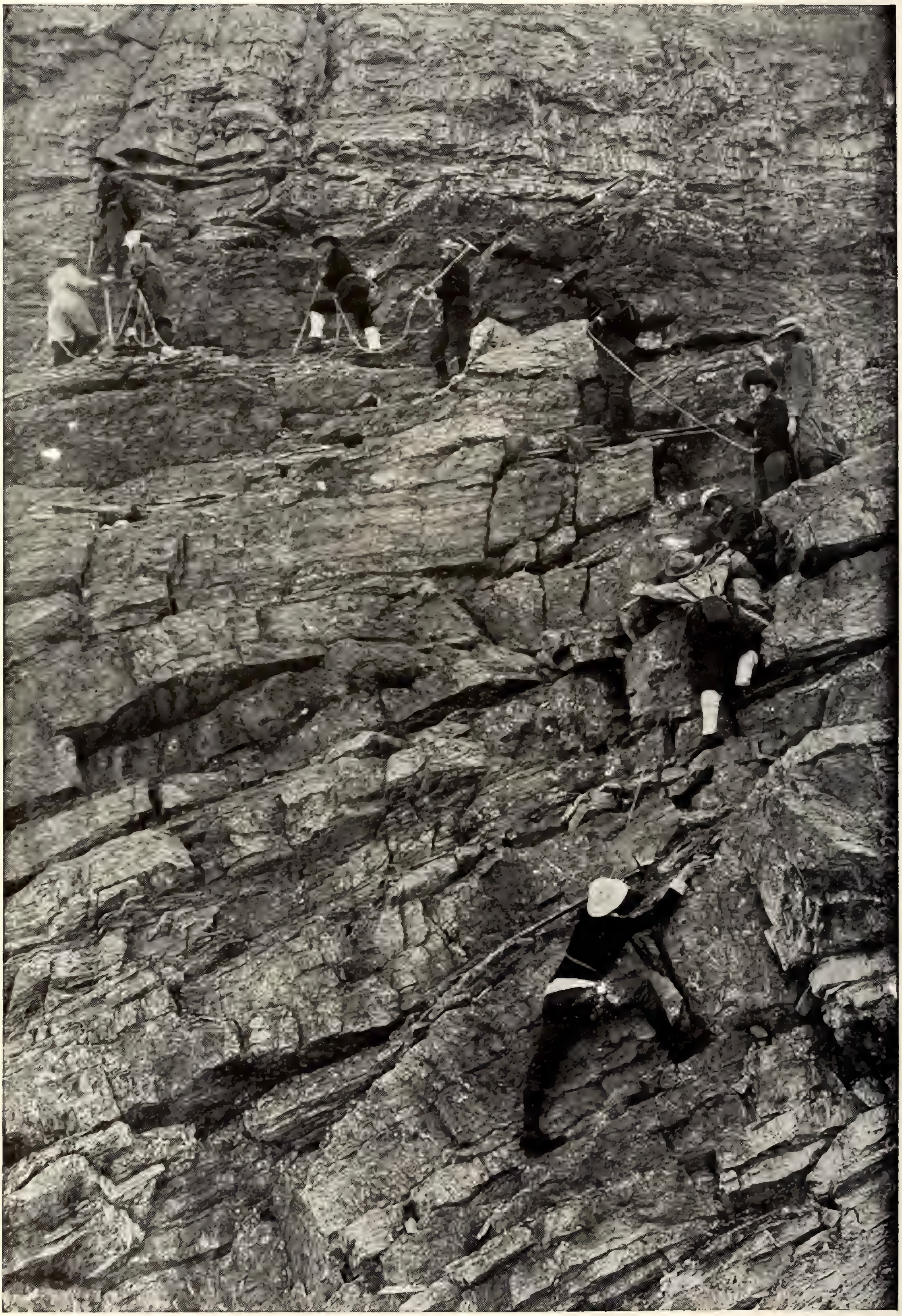
A SHOULDER OF MOUNT VICE-PRESIDENT, OVERLOOKING EMERALD LAKE, NEAR FIELD, BRITISH COLUMBIA

The upper falls in the photograph are about 200 feet high. Photo by Rev. George Kinney



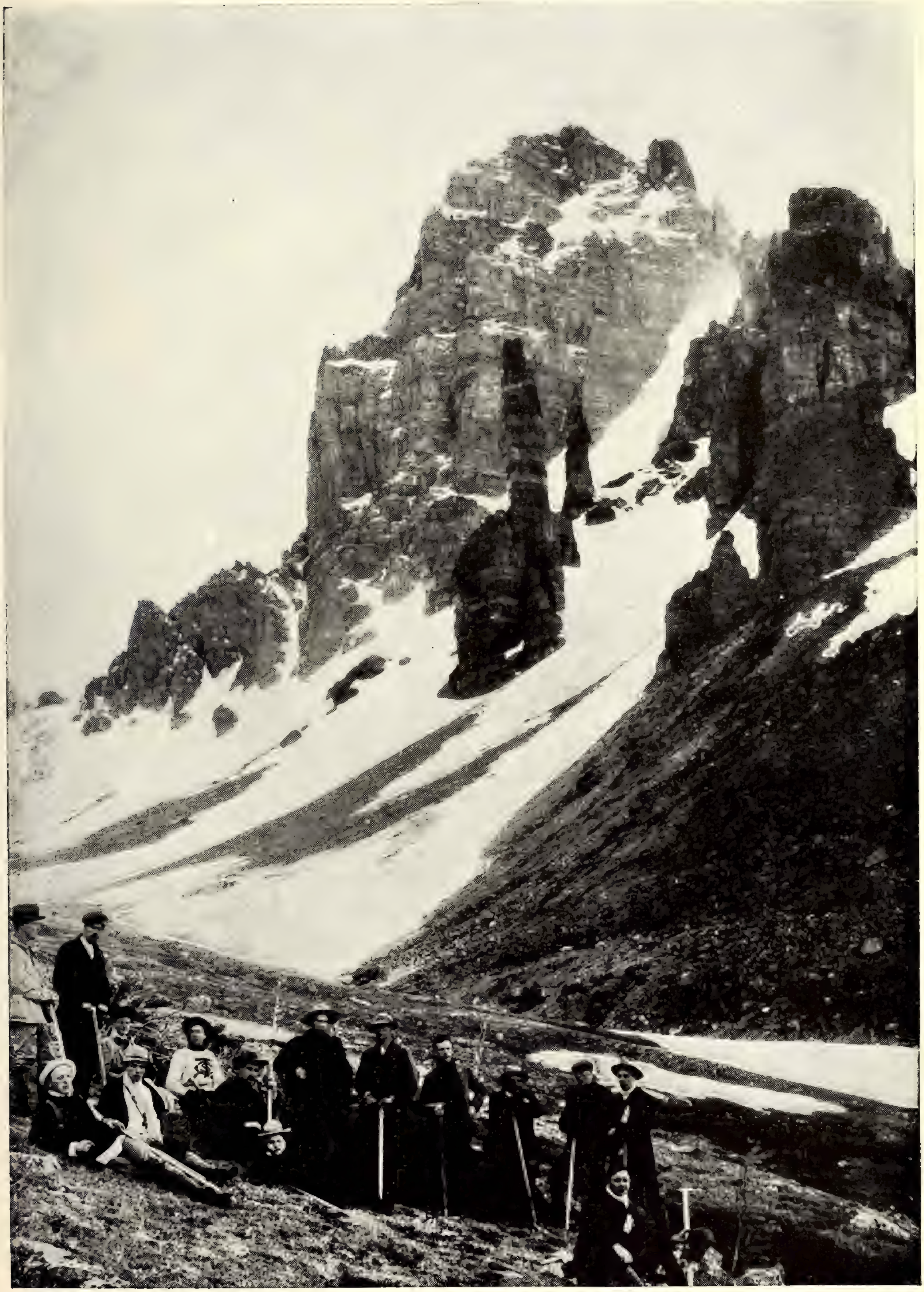
TAKAKKAW FALLS (1,200 FEET), IN THE VALLEY OF THE YOHO, BRITISH COLUMBIA

Fed by the great Daly Glacier, which is backed by a snow-field of many square miles in extent, the Takakkaw Falls leaps full fledged over a cliff 1,200 feet high, thus forming the crowning wonder of the marvelous Valley of the Yoho, near Field, B. C., in the Canadian Rockies. Photo by Rev. George Kinney.



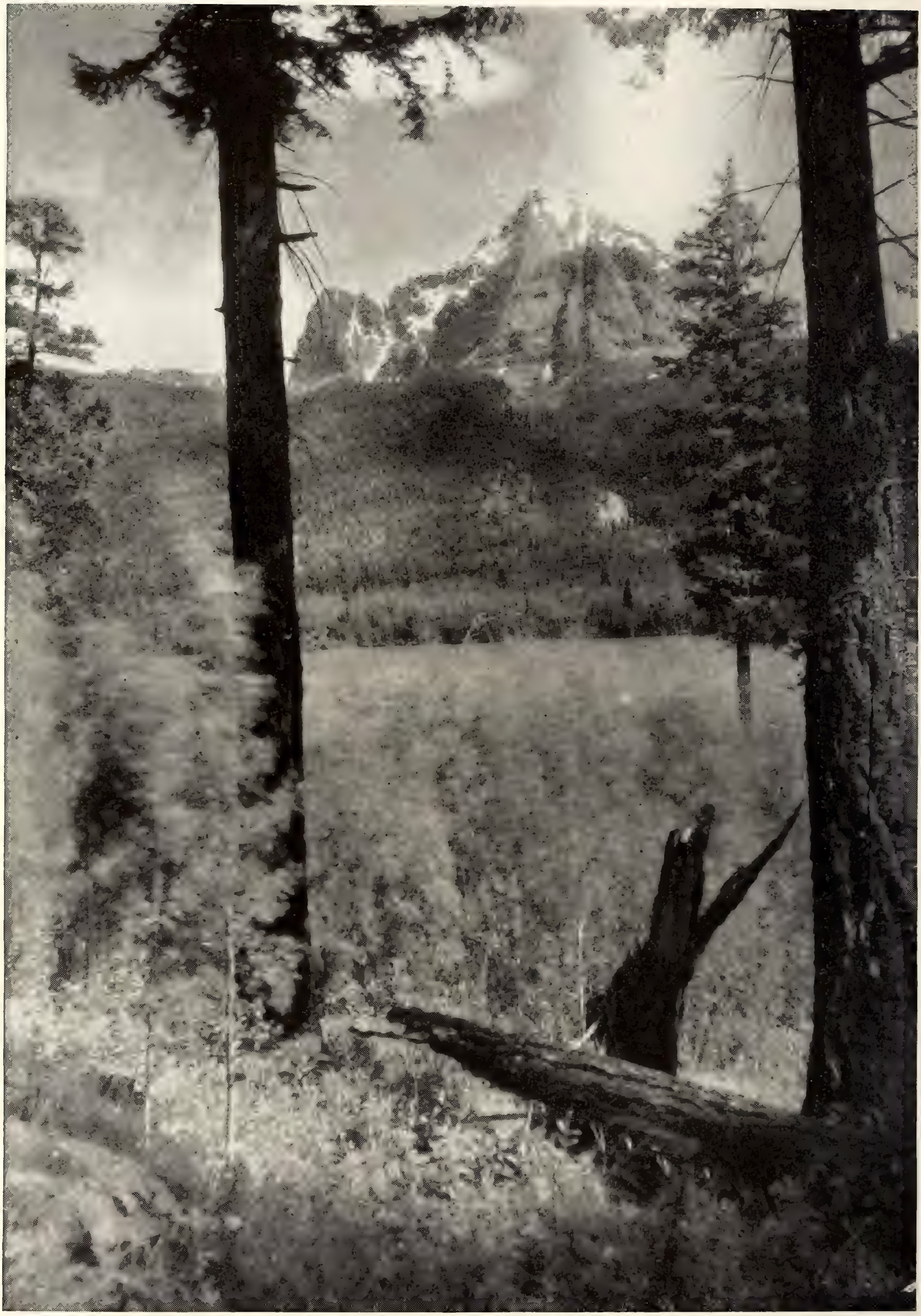
MEMBERS OF THE ALPINE CLUB OF CANADA ASCENDING MOUNT VICE-PRESIDENT

A difficult piece of rock-work. Under the care of expert guides the members thus qualify for active membership. Photo by Rev. George Kinney



MOUNT PINNACLE AND SENTINEL PASS, NEAR PARADISE VALLEY, BRITISH COLUMBIA

This splendid peak, rising out of Paradise Valley like a jeweled needle tipped with pearl, stands side by side with Mount Temple, in the Canadian Rockies, and overlooks the celebrated "Valley of the Ten Peaks." Photo by Rev. George Kinney.



MOUNT PEELEE AND THE YELLOWHEAD LAKES: CANADIAN ROCKIES

Yellowhead Pass, sentineled by Mount Peelee and the Yellowhead Mountains, offers for the transcontinental railroads the lowest and easiest gateway through the Canadian Rockies. Gigantic Douglas firs make picturesque the shores of the lakes in this region. Photo by Rev. George Kinney.

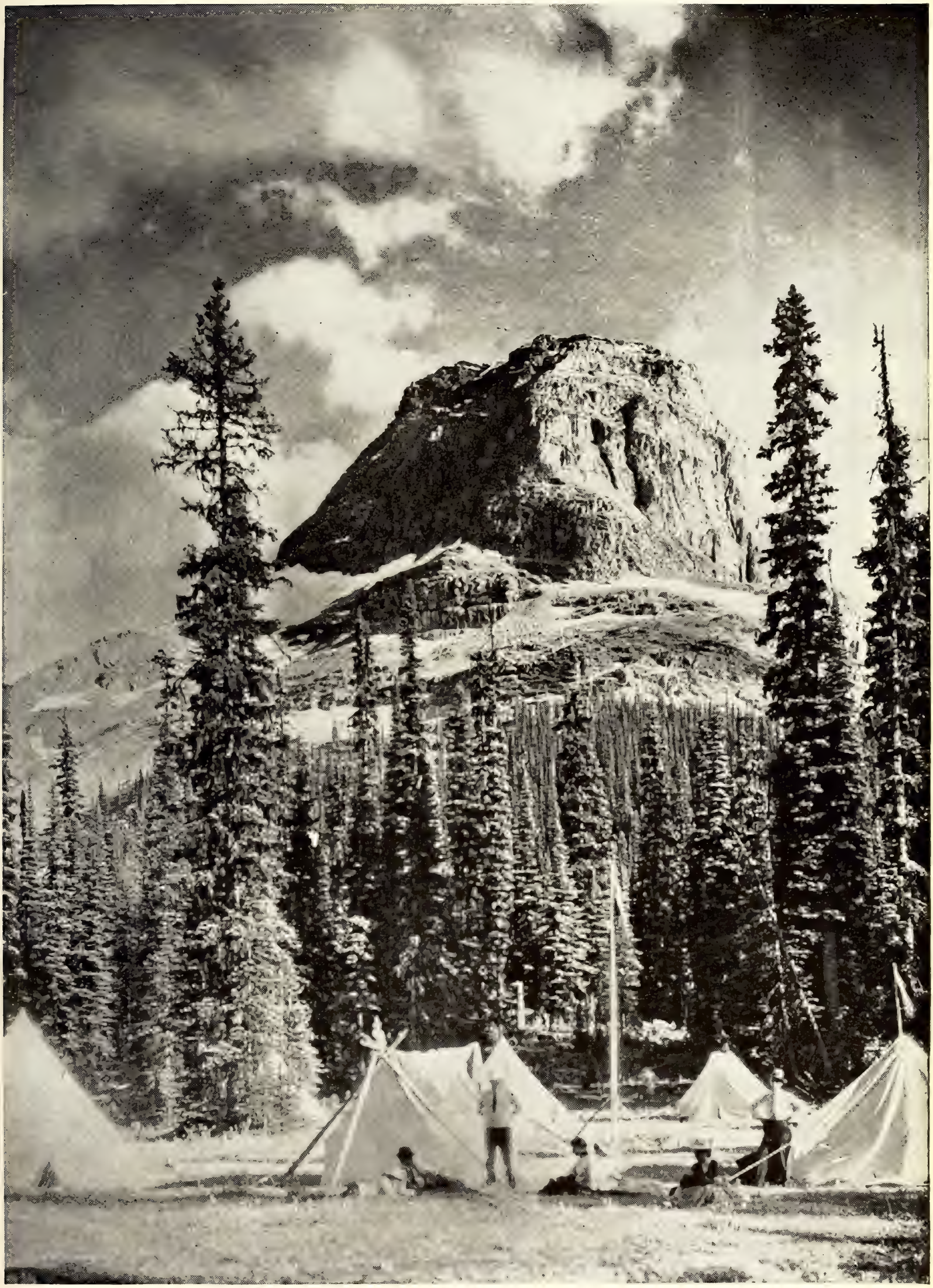


Photo by Rev. George Kinney

MOUNT WAPTA, NEAR FIELD, BRITISH COLUMBIA, AND THE FIRST CAMP OF THE ALPINE CLUB OF CANADA (SEE PAGES 519-520)

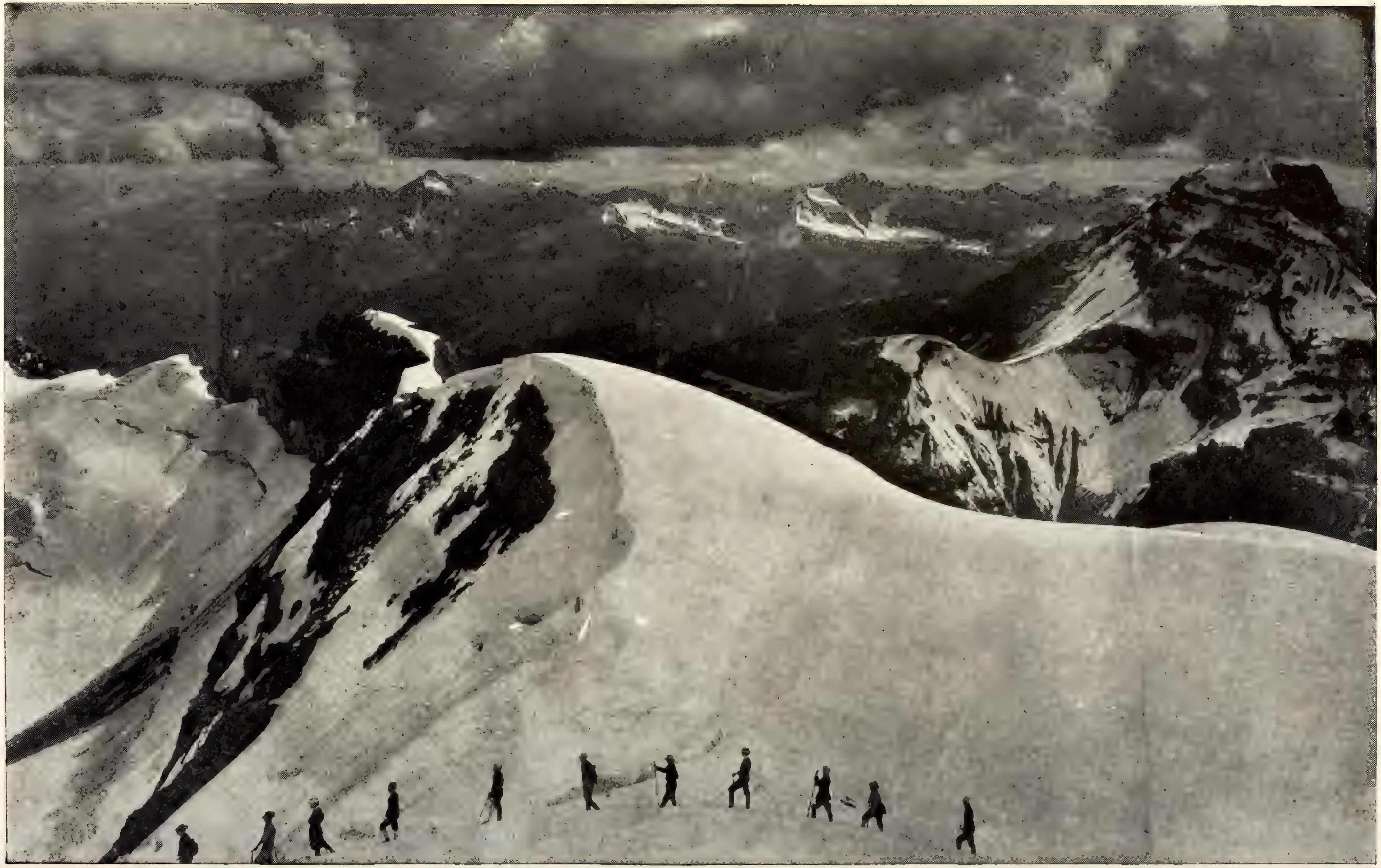
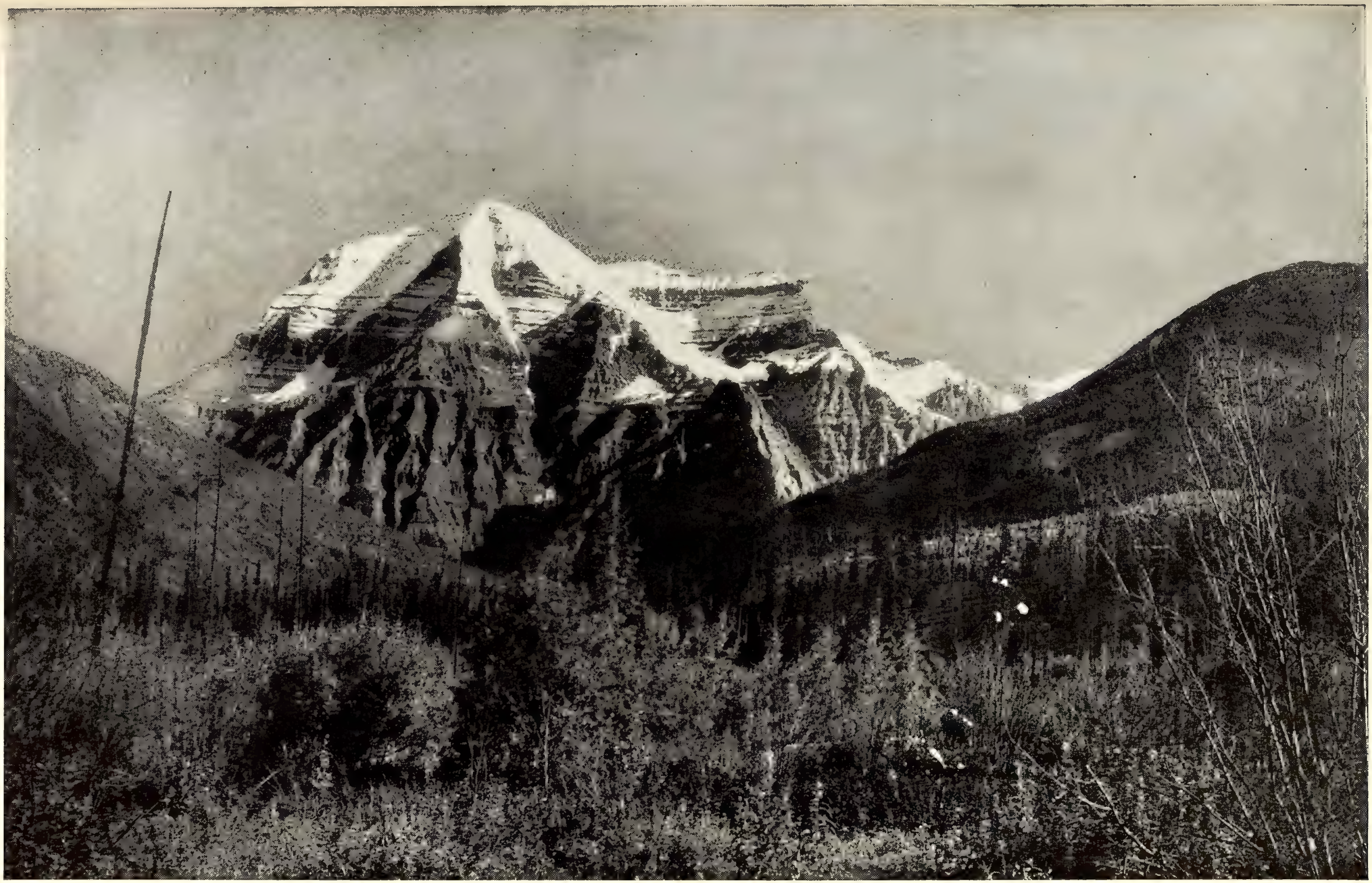


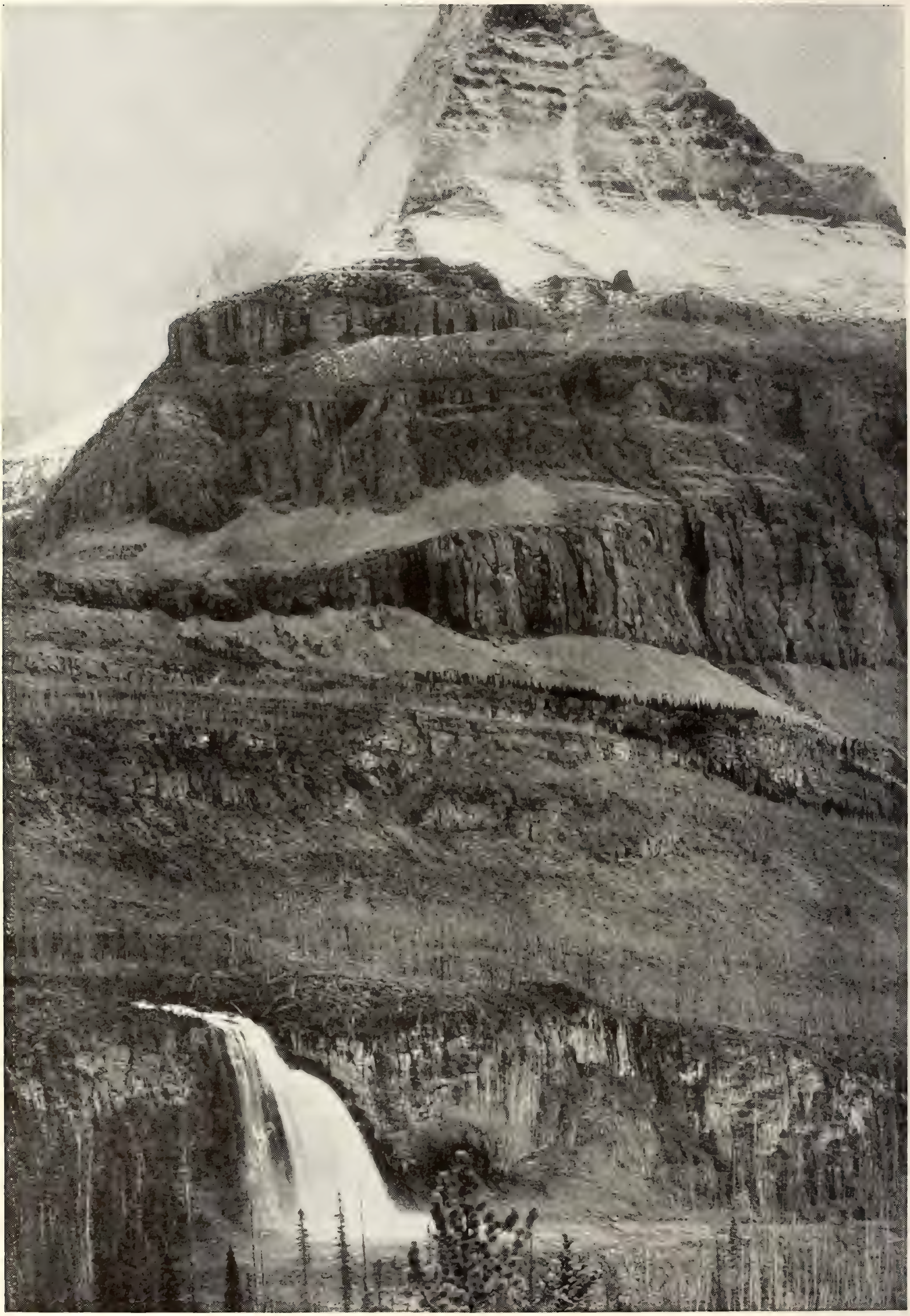
Photo by Rev. George Kinney

TWO ROPE PARTIES OF THE ALPINE CLUB OF CANADA CROSSING THE GREAT SNOW-FIELD ON THE SUMMIT OF MOUNT VICE-PRESIDENT, NEAR FIELD, BRITISH COLUMBIA, AT OVER 10,000 FEET ALTITUDE



MOUNT ROBSON (NEARLY 14,000 FEET ALTITUDE), KING OF THE CANADIAN ROCKIES

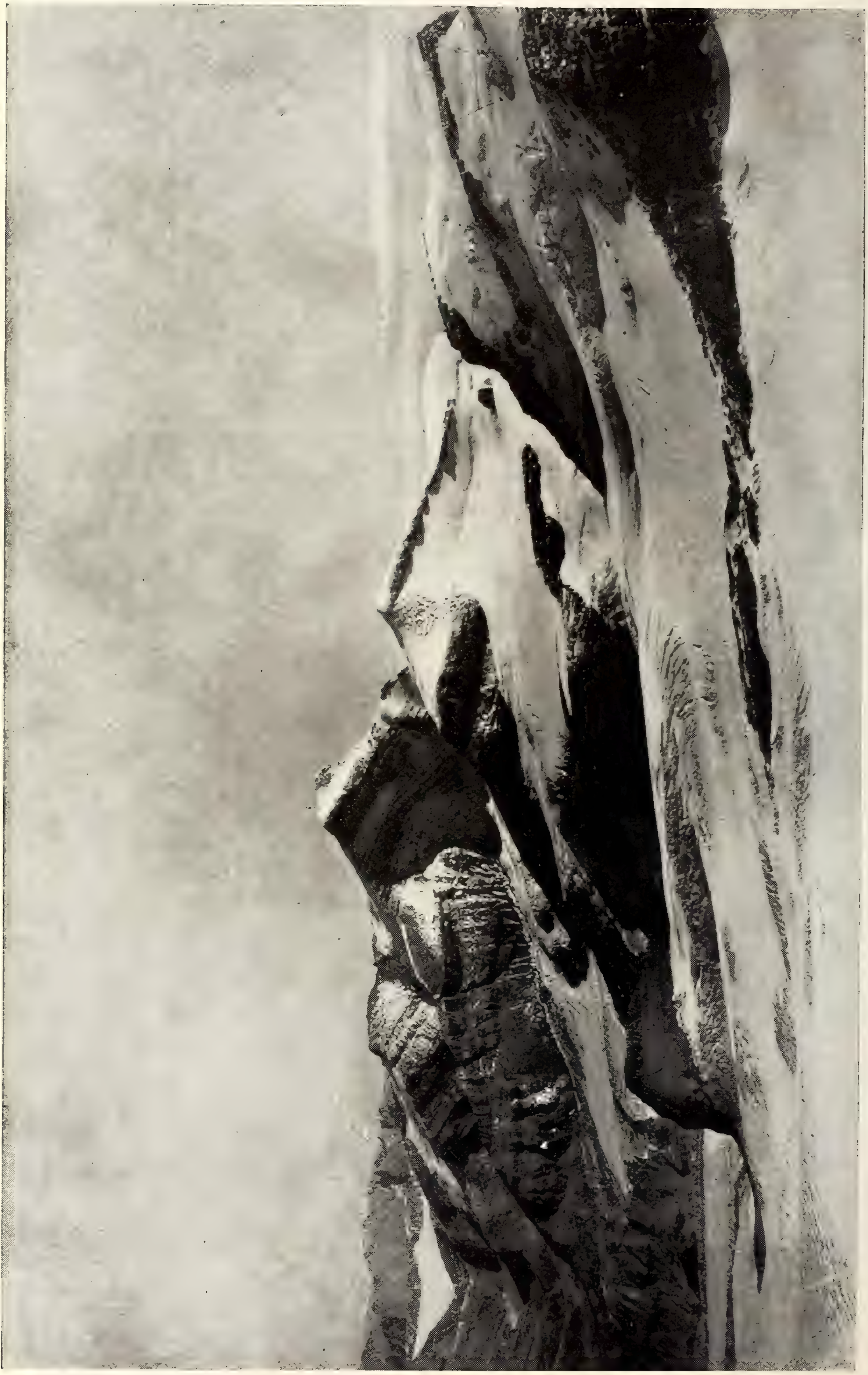
As the tourist on the Grand Trunk Pacific will see it, from the mouth of the Grand Forks, on the Fraser River. This monster peak, towering over 10,000 feet above Lake Kinney, in the valley below, at an average angle of over 60 degrees, was finally captured, in 1909, by two Canadians, Rev. George R. B. Kinney and his companion, Donald Phillips. It is the highest mountain yet discovered in the Canadian Rockies. Photo by Rev. George Kinney.



The north face of Mount Robson rises abruptly in a series of precipitous cliffs, rank on rank, to the very skies. At its base the Grand Forks River, swiftly flowing from Berg Lake, leaps a cliff as high as a Niagara and, plunging in a succession of superb falls through a gorge over 3,000 feet deep, sweeps through the "Valley of a Thousand Falls" on its way to the Fraser. Photo by Rev. George Kinney.

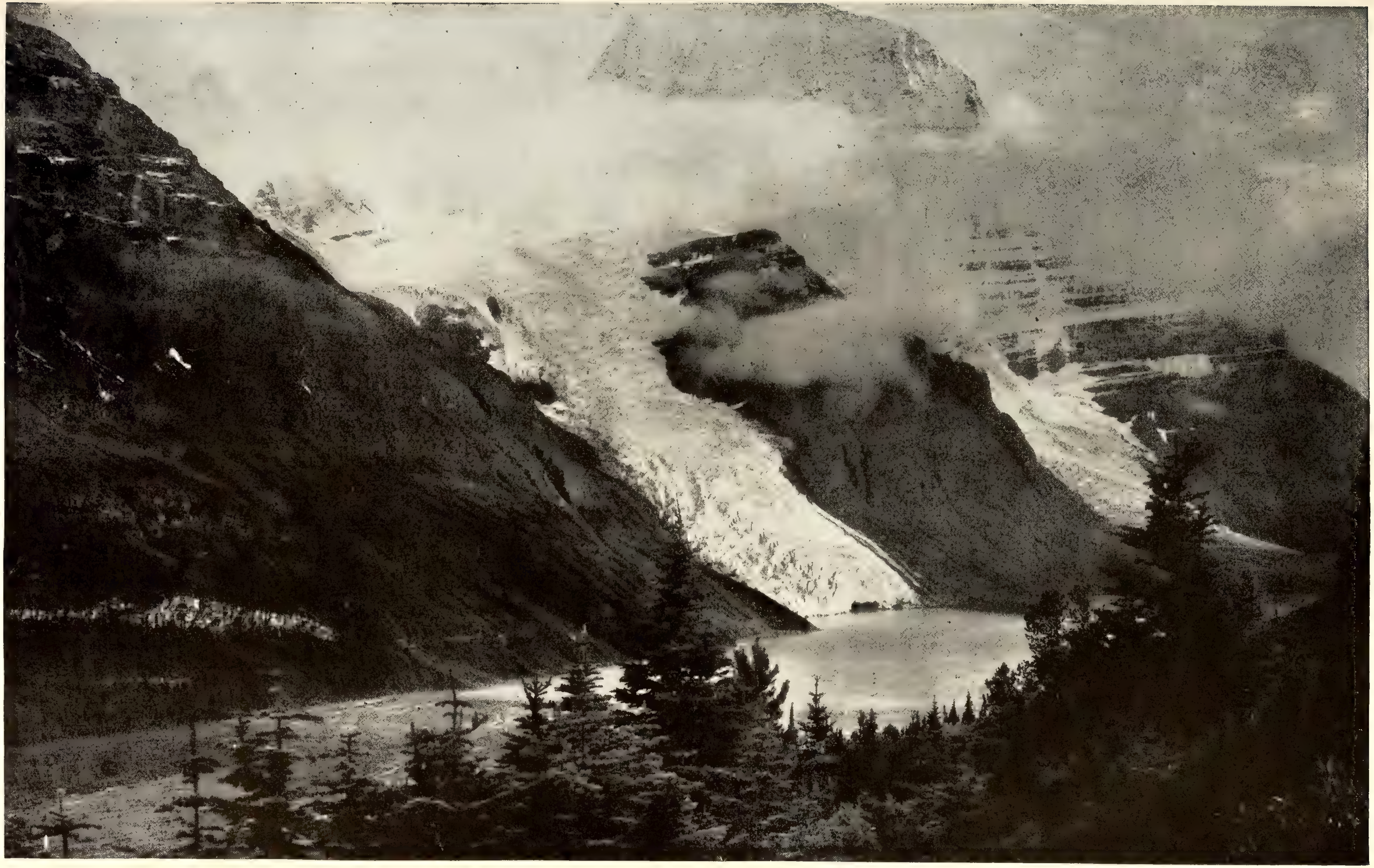
CLIMBING THE ICE-CLIFFS OF THE EAST SIDE OF MOUNT ROBSON: CANADIAN ROCKIES

Dr. A. P. Coleman, L. Q. Coleman, and Rev. George R. B. Kinney working their way up the fearful ice-cliffs of the east side of Mount Robson in their unsuccessful attempt to climb the mountain in 1908. Leaving their camp at tree-line, for 14 hours they fought their way up those treacherous walls of ice amid constant dangers from hidden crevasses and roaring avalanches, but only attained an altitude of 11,700 feet. Photo by Rev. George Kinney.



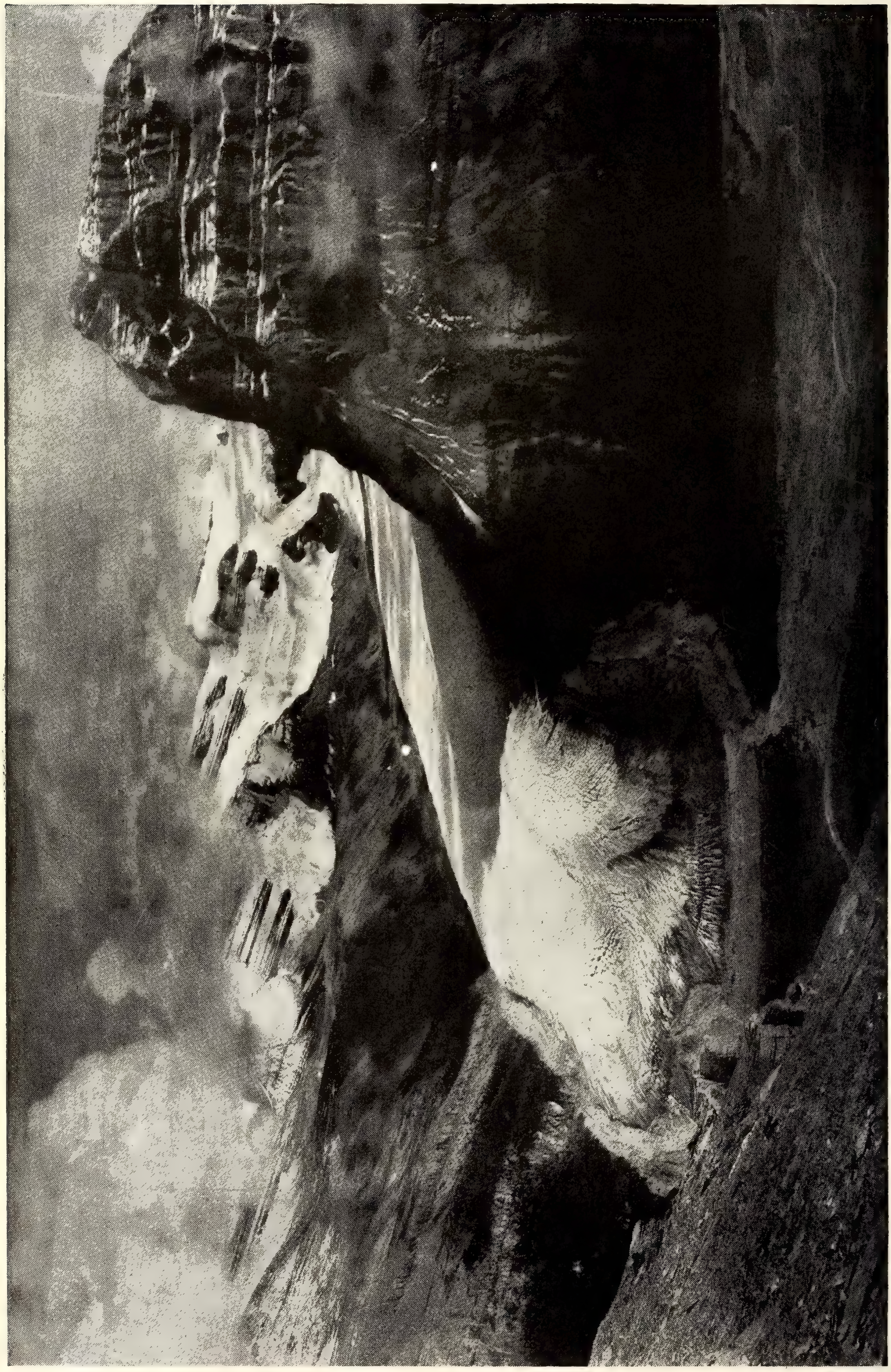
LOOKING EAST AND SOUTH FROM MOUNT ROBSON : CANADIAN ROCKIES

This view was taken from the east side of Mount Robson at an altitude of over 10,000 feet, high up on the crumbling cliffs of the névé from which the great East Glacier flows (see page 534). From this altitude the snow-capped peaks to the south spread out like the surface of a rugged plain. Photo by Rev. George Kinney.



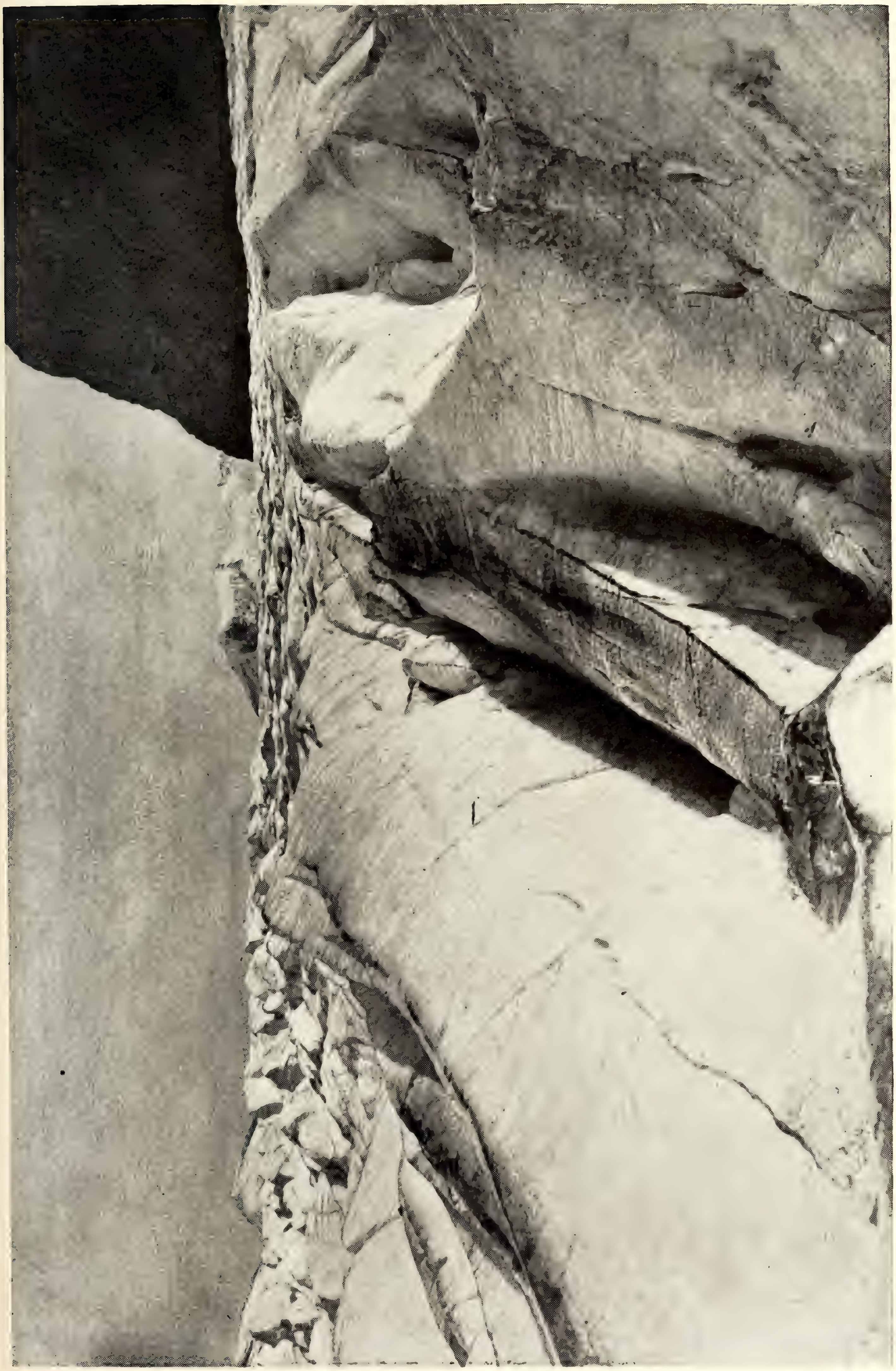
EAST SIDE OF MOUNT ROBSON, CANADIAN ROCKIES, FROM TIMBER LAKE

Looking from the east, Mount Robson, in the Canadian Rockies, rises out of one of the most beautiful valleys in all the world of alpine scenery. Six mighty glaciers, the least of which measures not less than a quarter of a mile wide, flowing from his rugged sides and those of the mountains opposite, pour their turbulent streams into the quiet waters of Berg Lake. This lake received its name because of its surface being constantly dotted with huge icebergs that plunge into it from Tumbling Glacier midway its length. Photo by Rev. George Kinney.



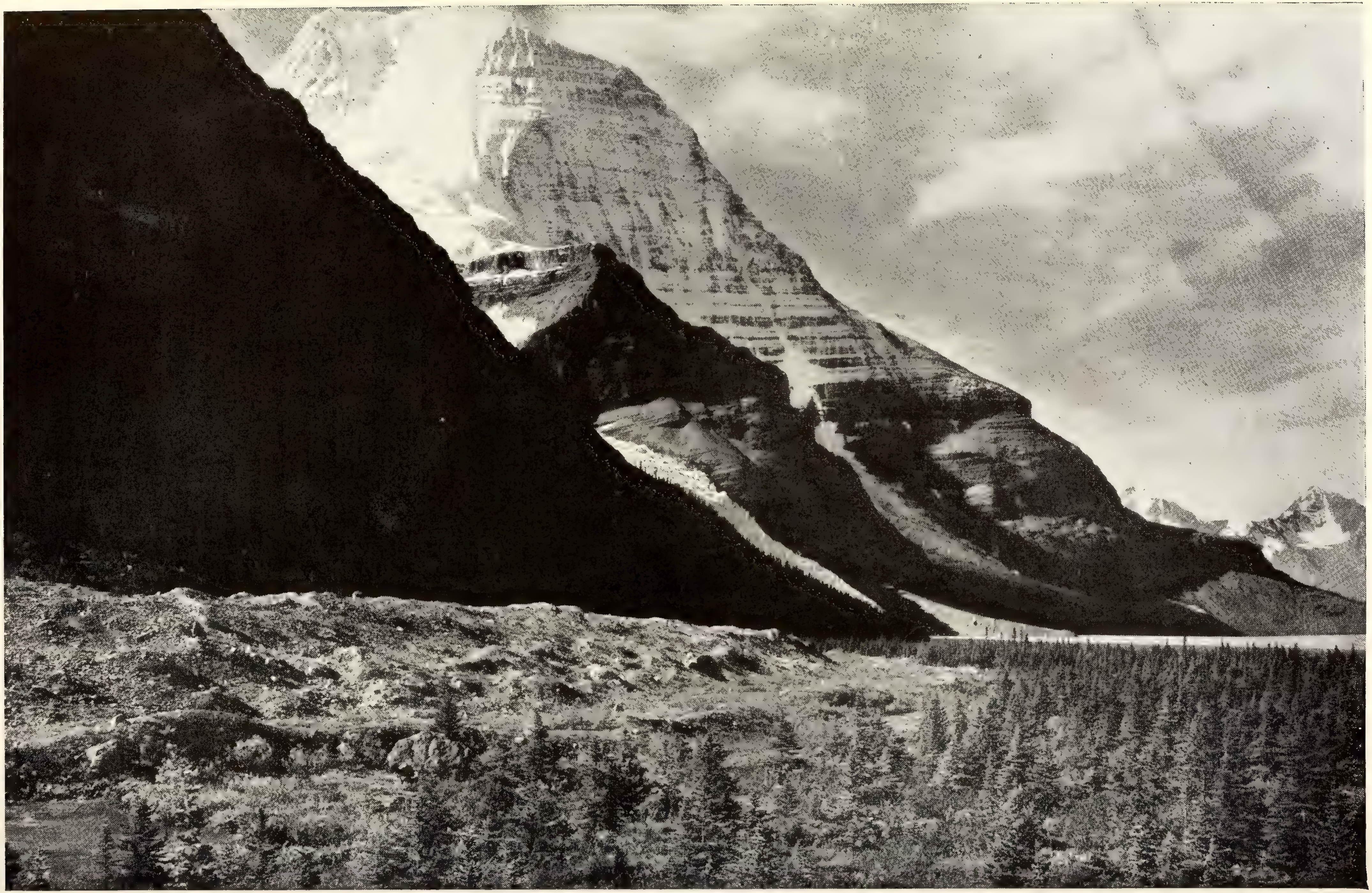
THE BIG GLACIER ON THE EAST OF MOUNT ROBSON

This mighty glacier, flowing from a huge snow-field on the east side of Mount Robson and curving in a wide crescent around the base of Mount Rearguard, is a mile wide and five miles long. The glacier forms a watershed, part of its waters flowing into the Pacific and part into the Arctic seas. Photo by Rev. George Kinney.



SURFACE OF THE BIG EAST GLACIER OF MOUNT ROBSON

The crevasses of this glacier are in some places several hundred feet deep, while its lateral and terminal moraines are thrown high on every side, and a splendid medial moraine marks its course. Photo by Rev. George Kinney



MOUNT ROBSON AND BERG LAKE FROM THE NORTHEAST: CANADIAN ROCKIES

So frightfully steep are its rugged sides, and so high does it rise out of its valleys (over 10,000 feet), and so frequent are the severe storms of the region that of all the expeditions that tried to capture Mount Robson, Mr. Kinney's, in 1909, was the only one that ever reached its summit. Even then he and his companions had to sleep several nights on its lofty snow-covered ledges and nearly perished.

THE NATIONAL GEOGRAPHIC SOCIETY RESEARCHES IN ALASKA

By Lawrence Martin

Leader of the National Geographic Society's 1910 Expedition to Alaska

The Research Committee of the National Geographic Society has made an appropriation of $5,000 from the research fund to continue the studies of the Alaska glaciers which were conducted by the Society in 1909 and 1910. The work this year is in charge of Prof. Ralph S. Tarr, of Cornell University, and Prof. Lawrence Martin, of the University of Wisconsin. These gentlemen were also in charge of the work in 1909, but in 1910 Professor Tarr had engagements in Europe, so that the entire work of that summer rested upon Professor Martin. An account of the National Geographic Society's 1909 expedition to Alaska was printed in the January, 1910, number of the National Geographic Magazine.

DURING the summer of 1910 nearly four months were devoted to a continuation of the glacier studies commenced in 1909 under the direction of the Research Committee of the National Geographic Society. It is fortunate that this fund is available just at the time when unusual activity of glaciers in Alaska is in progress. The glaciers are now so active that it is perhaps the opportunity of a century or more.

The field investigated in 1910 was Prince William Sound, but a two weeks' visit was made to Yakutat Bay in June to record the latest news from the unusually interesting active glaciers there, and a fortnight at the end of the season was devoted to the glaciers of the lower Copper River.

The party consisted of seven men—the author; W. B. Lewis, of the U. S. Geological Survey, topographer; E. F. Bean and F. E. Williams, of the University of Wisconsin, the former taking charge of the sounding and weather records, the latter acting as rodman; E. A. Connor and R. F. Byers, of the University of Washington, respectively boat engineer and photographer, and a Japanese cook. F. M. O'Neill, of Memphis, Tennessee, was also employed as engineer the latter part of the season. We started May 28 and were gone until Sept. 23.

One of the large glaciers in Yakutat Bay, the Nunatak, had changed a great deal since the year before. It had advanced decidedly, different parts of its front having come out 700 to 1,000 feet up to June 17, 1910. From 1890 to 1909 the Nunatak Glacier receded steadily, going back over two miles and a half in this time. We had anticipated that it would eventually advance, however, as was predicted in the National Geographic Magazine for January, 1910, and the forward movement commenced between July 6, 1909, and June, 1910. This was due to the accession of unusually large quantities of snow to the reservoirs of this glacier by avalanches during the 26 days of severe earthquakes of September, 1899.

The Nunatak was the ninth glacier in the Yakutat Bay region to respond since 1899 to this new cause for glacier advances in mountain regions. Their responses have come after a certain delay, dependent in part upon the length of the glacier, as the accompanying table shows.

Glacier.	Date of advance.	Length of glacier.
Galiano	After 1895 and before 1905	2 or 3 miles.
Unnamed glacier	1901	3 or 4 miles.
Haenke	1905-6	6 or 7 miles.
Atrevida	1905-6	8 miles.
Variegated	1905-6	10 miles.
Marvine	1905-6	10 miles.*
Hidden	1906 or 7	16 or 17 miles.
Lucia	1909	17 or 18 miles.
Nunatak	1910	20 miles.

* Excluding expanded lobe in Malaspina.

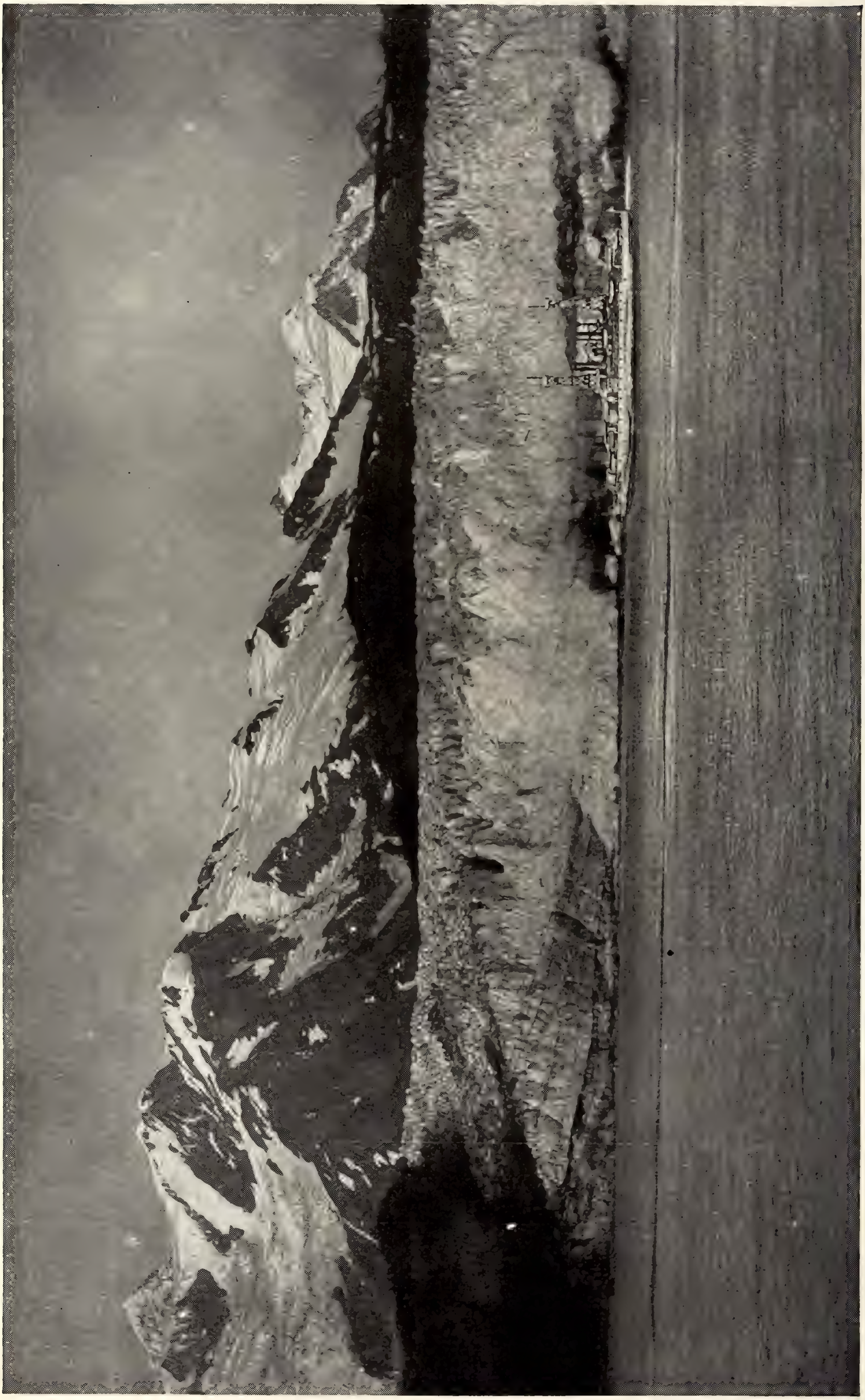
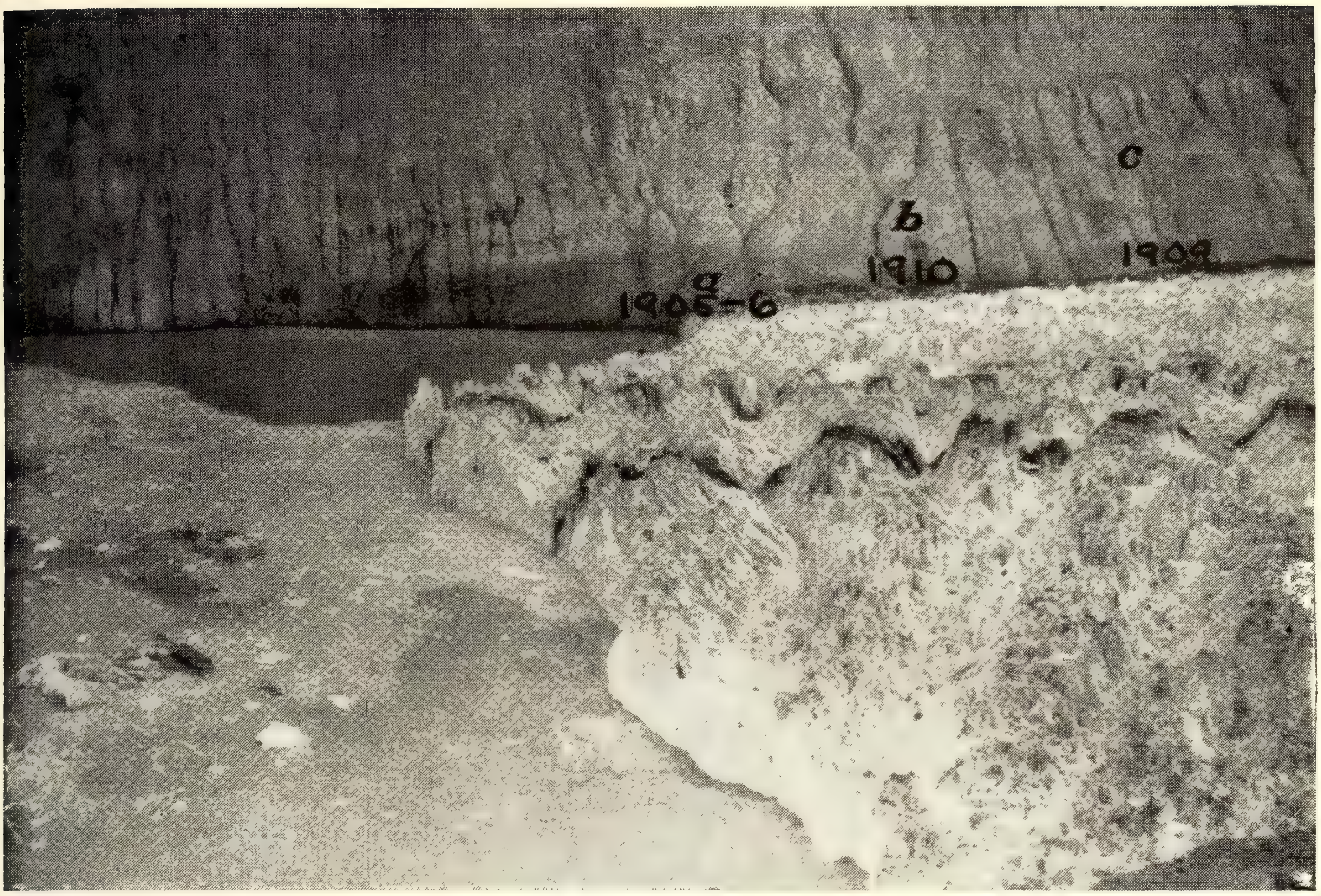


Photo by Lawrence Martin

PORTION OF THE CLIFF OF LA PEROUSE GLACIER, COMPARED TO THE BATTLESHIP MICHIGAN



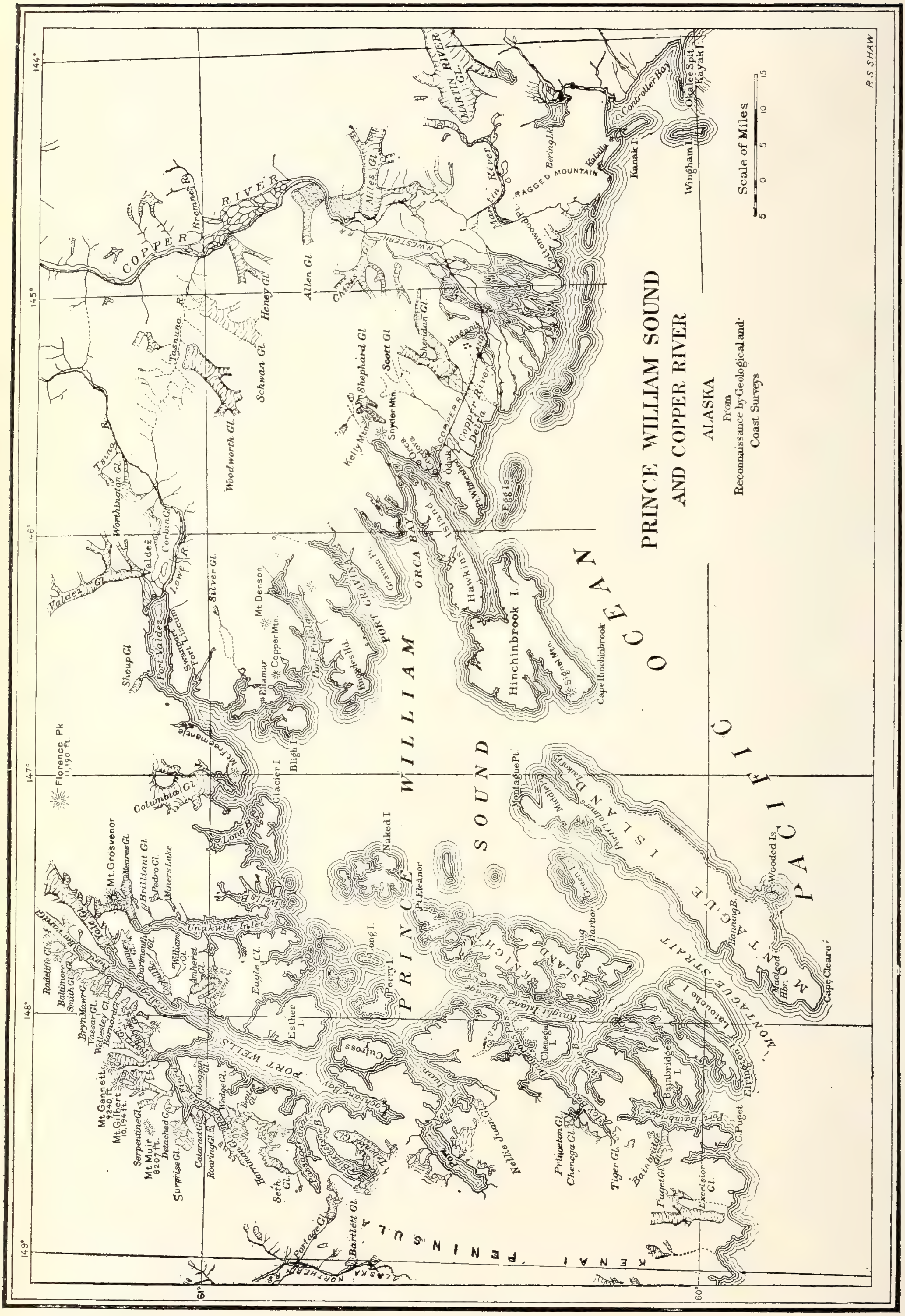
GLACIER RESPONDING TO EARTHQUAKE

The retreat of Nunatak Glacier from 1905 to 1909 (*a* to *c*), followed by advance (*c* to *b*) before June, 1910. Photo by Lawrence Martin

The second of these glaciers, which is a small unnamed ice tongue between Haenke and Hubbard, was stagnant and moraine covered in 1899 and 1905, and I had not learned until the winter of 1910 that it was crevassed and advancing in 1901, as a photograph proves. Besides these nine, three or more of the smaller glaciers probably advanced between 1899 and 1905, and the neighboring Turner and Hubbard glaciers have each had one or more minor advances, perhaps due to the thrust from some responding tributary far back in the mountains. Hubbard Glacier, which may be twice as long as Nunatak, began such a minor advance in 1909, but in 1910 it had not progressed very far, though the west part of the ice front had come forward 600 feet and the crevassed area of the east margin had increased slightly. Other points on the ice front had retreated 500 to 1,000 feet between 1909 and 1910.

Lucia Glacier, which was advancing so rapidly in 1909, had perhaps nearly ceased its unusual activity; at least, when we saw it in 1910 it had not overridden the Lucia nunatak, which it surrounded and nearly covered the year before, and no great abundance of new streams emerged from its borders to Yakutat Bay. This, I am sorry to say, was all we were able to determine about Lucia Glacier, for we were unable to visit it and see more because of the unusual ice-jam in Yakutat Bay in June, 1910. From what we were able to see of it from a distance with field glasses, however, it was apparently behaving as all the other glaciers have when affected by the earthquake avalanche supply. The advance was sudden, the transformation great, and the activity was soon over. This seems to be the case in Lucia Glacier.

How great the advance of Nunatak Glacier will be is impossible to predict at present, for this is the first great tidal glacier in Yakutat Bay to advance since the earthquakes. If the slightly smaller



MAP SHOWING LOCATION OF THE GLACIERS OF PRINCE WILLIAM SOUND

This sound was formerly entirely covered by a glacial sheet (see page 560) non-tidal Hidden Glacier could move two miles under this impulse, however, the Nunatak Glacier might be expected to respond similarly, unless (1) this is only a minor thrust from some tributary or (2) the tidal condition introduces some complication not previously observed in studying glacial oscillations due to this new cause.

A GLACIER THREATENING A RAILWAY BRIDGE

On the lower Copper River is Childs Glacier, which is seriously threatening to destroy a steel railway bridge just completed. The rate of glacier motion in Childs Glacier increased during the winter of 1909-1910 so that part of the margin of the glacier changed its forward movement from nothing to two and as much as eight feet a day.

This glacier, as the map shows (page 543), is the smallest of three great ice tongues—Miles, Childs, and Allen glaciers—projecting into the Copper River valley. Around these three the Copper River winds through a succession of rapids and lake-like stretches. The Copper River and Northwestern Railway has just been built between Childs and Miles glaciers and on over 5½ miles of the stagnant ice of Allen Glacier. Childs Glacier is 10 to 12 miles long, not much over a mile wide in the mountain valley, but it widens to over three miles in Copper River valley.

Its front is a precipitous white wall 250 to 300 feet high, and is swept at the base by Copper River. How a small section of the front of Childs Glacier compares with the Capitol building at Washington is shown in the photograph on page 546. The map on page 543 compares Childs Glacier graphically with the Nisqually Glacier, one of the largest ice tongues on Mount Rainier, and Miles Glacier with four of the largest and best-known glaciers of the Canadian Selkirks and the Glacier National Park in the Montana Rockies.

In August, 1909, Childs Glacier was advancing at about its normal rate—four feet a day at a point near the north side and perhaps six or seven feet a day in midglacier. The melting and the many icebergs discharged from the terminal cliff at that time just about balanced this advance, so that the front of the glacier remained in about the same place. Near the north margin there was no advance when we saw Childs Glacier in 1909, and probably there had been none since 1905 and perhaps none to speak of since 1884, though its relationship to the river had varied slightly during this period, and slight crevassing had begun in 1906 and 1909 where there was none in 1905.

During the winter and early spring of 1909-1910, however, the glacier began to advance more rapidly, buckling up the ice of the frozen river. In June, 1910, the ice front had moved forward from 920 to 1,225 feet, narrowing the river to 400 or 500 feet.

Every time the ice cliff was sufficiently undercut by the river, great masses of ice would cascade down the front, raising a gigantic wave in the river. People in Alaska speak of the discharge from the front of Childs Glacier as "sloughing." A "slough" has always raised waves in Copper River, making it dangerous to shoot the rapids in front of Childs Glacier in a boat, or to line a boat up the opposite bank; but in the spring of 1910 the conditions were accentuated by the advance of the glacier and the pushing of the river eastward.

During the advance the waves washed up over a bank 5 to 25 feet in height and rushed back 100 or 200 feet into the alder thicket. Ice blocks up to 10 tons in weight were thrown in among the trees. Stones a foot or two in diameter were hurled into the thicket. Alders 9 to 11 inches in diameter were stripped of leaves and bark and bent backward or broken off short, or uprooted or buried beneath the gravel and boulders and macerated trunks of other trees.

The river bank, which was cut back some in the preceding year, was in 1910 being fairly eaten up by the iceberg waves which crossed the river, 50 to 60 feet by actual measurement having been removed along the bank of the stream facing the glacier.

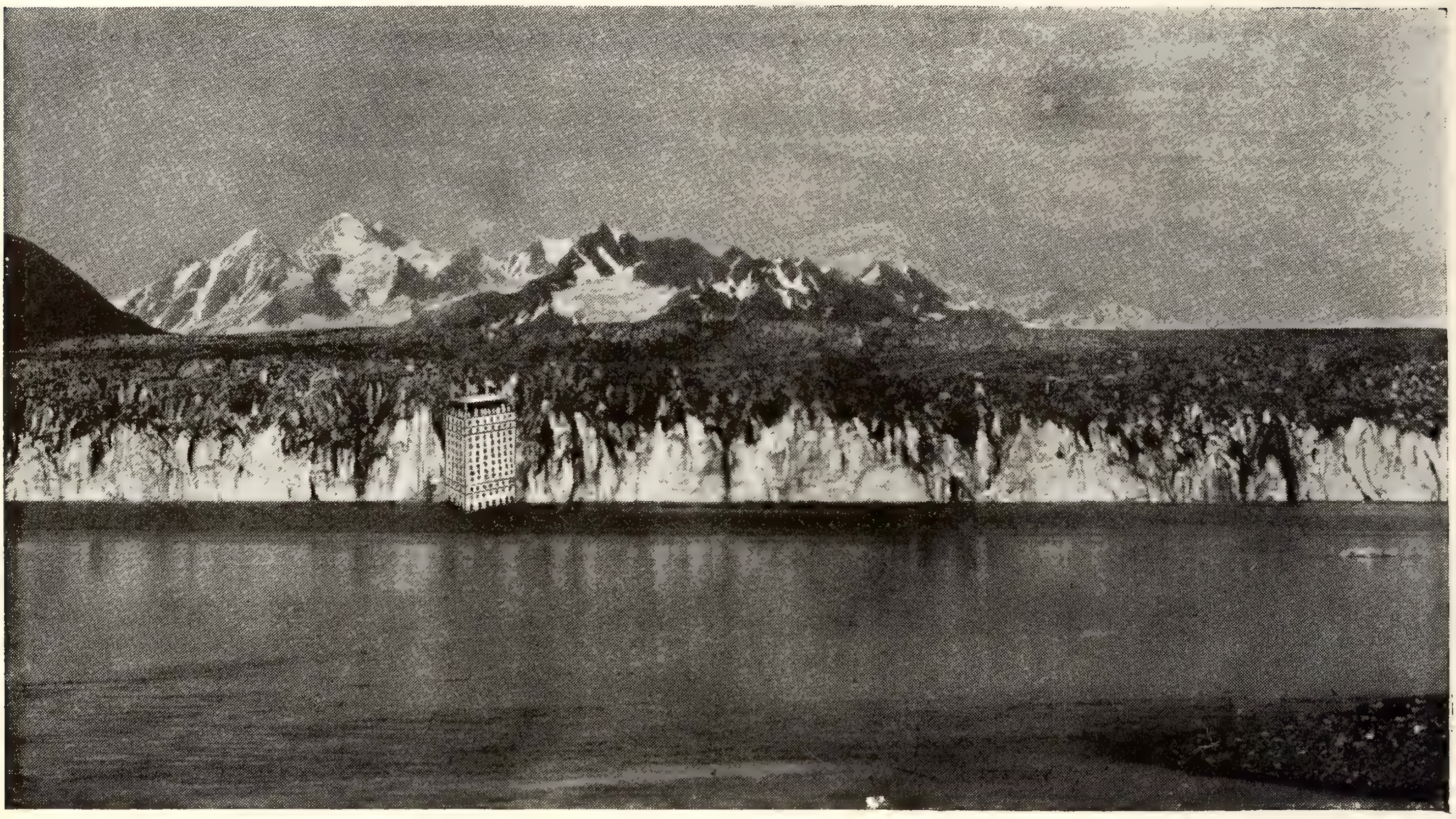


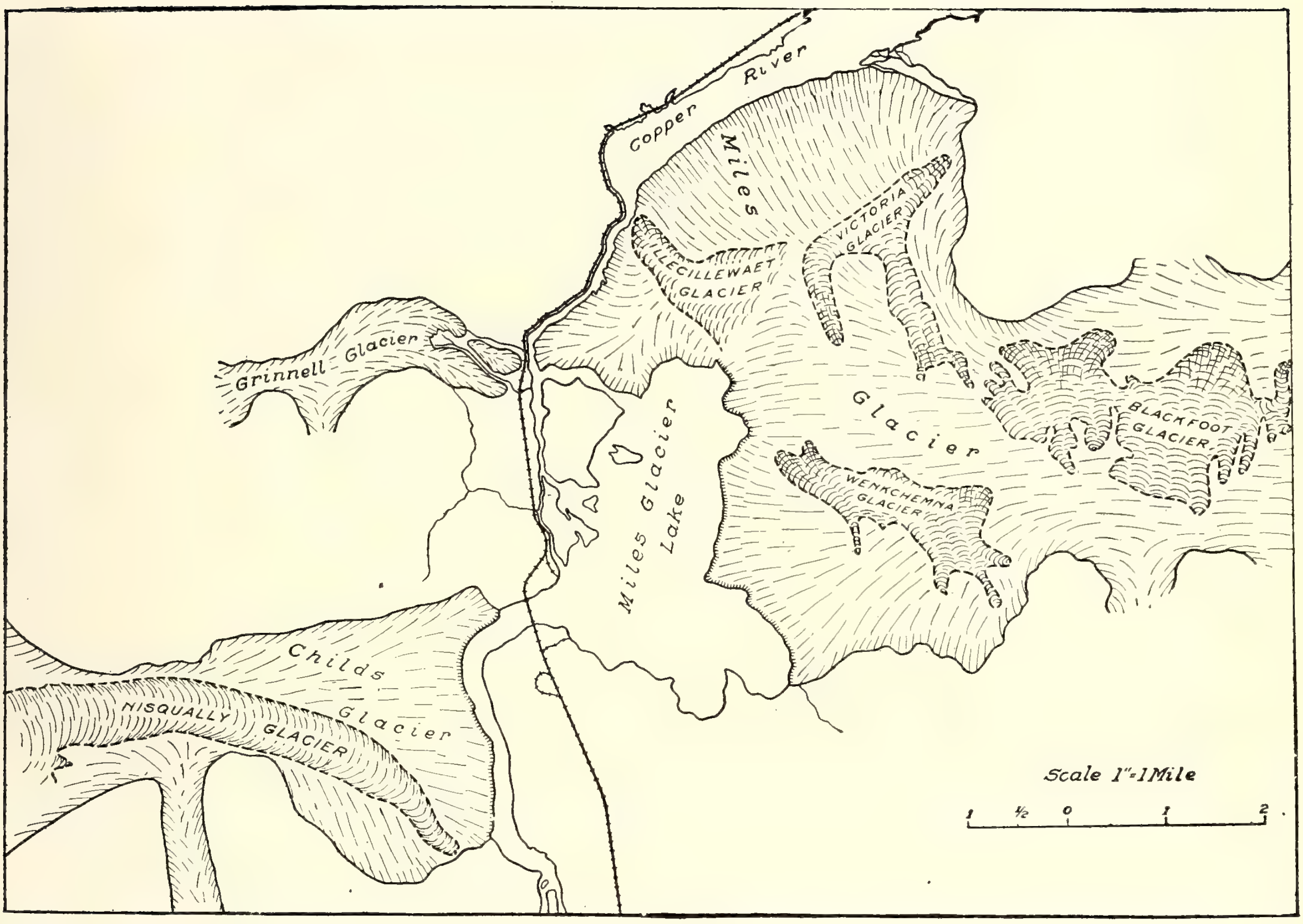
Photo by Lawrence Martin

A SMALL PORTION OF THE FRONT OF MILES GLACIER, FROM THE BRIDGE ON COPPER RIVER & NORTHWESTERN RAILWAY, COMPARED GRAPHICALLY WITH THE HOTEL LA SALLE, IN CHICAGO, WHICH IS 310 FEET HIGH

Late in August, 1910, when the waves were not as powerful as they had been earlier in the summer, the largest ice fall, or slough, from Childs Glacier which I saw sent a wave across the river with lightning rapidity, causing the water to splash up over the 15 or 20 foot bank, near where I stood, and back a short distance into the forest. It of course rose highest directly opposite the ice fall, the height of the wave on the bank decreasing both up and down stream. Six or seven ring-waves in succession splashed far up the river bank, the first one visibly running upstream against an eight or nine mile an hour current. It was easy to see how the larger waves during the first part of the summer were able to cut back the river bank so easily.

Near the north margin of the glacier is an easily accessible portion of the ice front which ends upon a nearly-flat outwash plain of glacial gravels, overgrown with alder and cottonwood trees 50 to 100 years old. Here the glacier was nearly without motion from 1905 to 1909, and probably for some years before, so that small shrubs had begun to grow upon the stagnant ice margin. This part of the glacier advanced 1,500 to 1,600 feet before June 10, 1910, and 204 feet more up to October 5. The rate of

Dates of observations.	Number of days.	Advance, in feet.		Rate per day, in feet.	
		Fastest.	Average.	Fastest.	Average.
June 10 to July 29	49	124	116	2.5	2.37
July 29 to August 6	8	26	23	3.25	2.87
August 6 to August 11	5	41	8	8.2	1.60
August 11 to August 17	6	27	4	4.5	.66
Aguust 17 to August 29	12	42	19	3.5	1.58
August 29 to September 19	21	37	27	1.76	1.28
September 19 to October 5	17	13	7½	0.7	.44



MAP COMPARING SIZES OF COPPER RIVER GLACIERS WITH GLACIERS IN THE ROCKY MOUNTAINS, SELKIRKS, AND CASCADES OF THE UNITED STATES AND CANADA

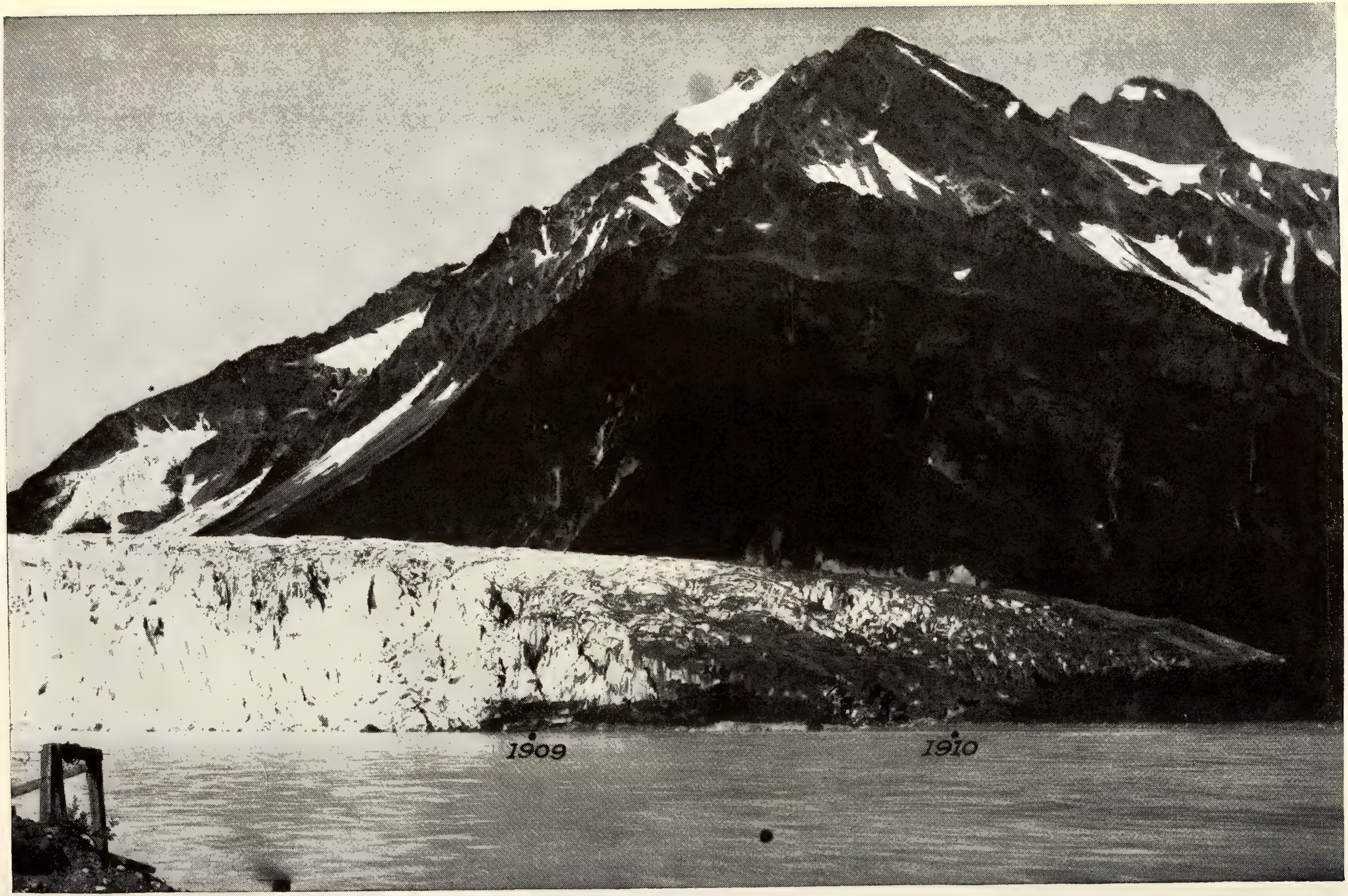
Note that the largest glaciers of the United States are in the Cascades, where the Nisqually Glacier of Mount Rainier exceeds in size the Blackfoot Glacier of the Glacier National Park, in the Montana Rockies. These and the Illecillewaet and other glaciers of the Canadian Rockies and Selkirks are much smaller than the Alaskan glaciers.

advance is phenomenal, averaging two to eight feet a day, and especially remarkable for the edge of a glacier, where movement is always slowest. The railway engineers made most of the surveys before we reached Childs Glacier and one after we left, but we made supplementary observations on a number of days between their surveys, finding the ice front advancing at rates intermediate between those shown on the maps. The rates per day are shown in the table on preceding page.

The rates of average movement show variations in velocity, with two maxima; the fastest movements show a very rapid increase in rate of advance to the maximum, between August 6 and 11, and an unusually rapid decrease again. This is one of the most rapidly increasing and decreasing series of glacier movements yet mapped.

It was a rare opportunity to see the visible forward movement of Childs Glacier into the forest. A series of lobes developed, though some of them were not persistent, and at the ends of these lobes the day-to-day changes were most pronounced. Ice blocks were sliding down the frontal slope, some of them being rolled many feet into the forest; trees were overturned, turf and grass were ploughed up and carried on the ice of the glacier.

Yet one saw and heard little of a spectacular nature while traversing the ice front. It was an irresistible, steady movement, but slow, as the movement of the hour hand of a clock is slow. As impressive as anything was to find tons of



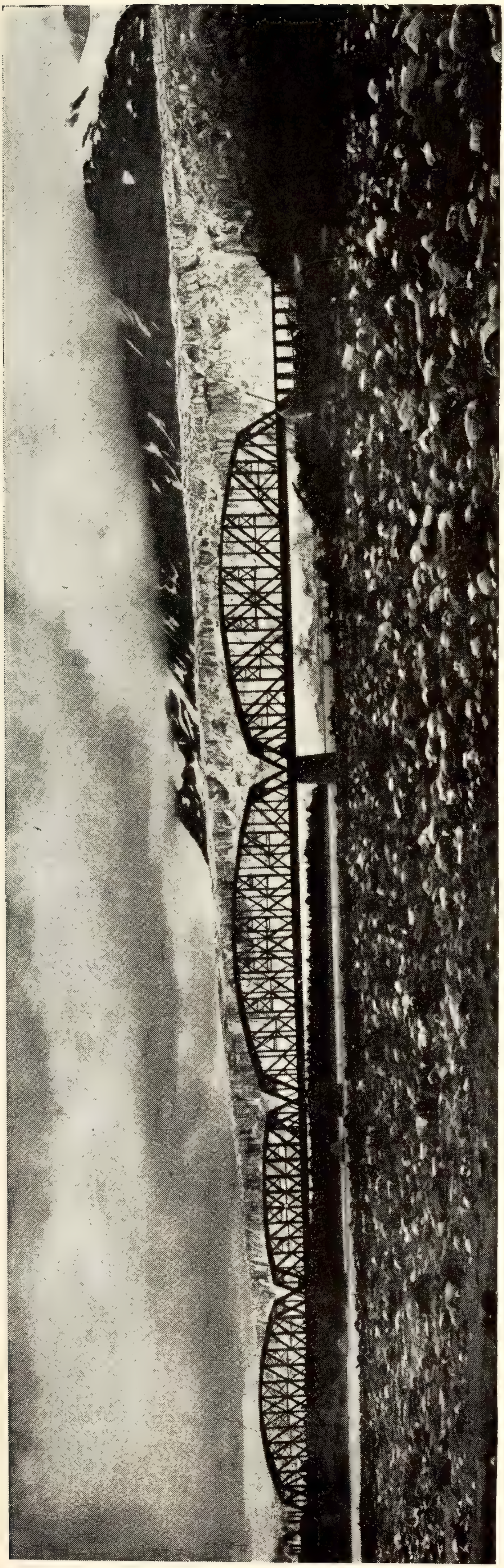
VIEW OF CHILDS GLACIER, AUGUST 21, 1910

Showing how much it had advanced in 14 months, or since our former visit, on June 20, 1909. The advance was 1,500 to 1,600 feet on the north bank, where the advance was less than in mid-glacier. The terminus also thickened noticeably. Photo by Lawrence Martin ice resting where one stood to take a photograph the day before, or to find some great tree, 100 years old, prone on the ground with the butt beneath the glacier, where the day before the tree was upright with the ice just touching it or with room to go between the glacier and tree.

The rate of movement in midglacier during the summer was not determined, but it would not be improbable, judging from the rate at the north margin and from rates at intervals across other glaciers that have been measured, that it was at least six times the rate in 1909, or 30 feet a day, and even more at times.

But the middle of the glacier did not advance as far during the summer as the north margin did, and between June 10 and August 11 it retreated 450 feet. From August 11 to August 17 it retreated 65 feet more. This retreat was occurring while the north margin was advancing most strongly, and it seemed to the National Geographic Society's party that this retreat was not due to a cessation of advance, but wholly to undercutting by the Copper River, which rose over six feet between June and August because of summer melting of snows and glaciers.

We accordingly predicted in August that the ice front in the river would readvance the latter part of September, when the river was lower. This prediction proved correct, the ice front advancing 390 feet up to October 5, plus the amount of additional retreat between August 17 and the date when the advance commenced, the level of the river having fallen nine feet meantime. As the middle of the glacier advanced 390 feet in the 49 days between August 17 and October 5, the minimum rate of actual advance was fully eight feet a day, if there was advance on each of these days. As (*a*) icebergs were discharging all the time and melting was in progress; as (*b*) the advance was surely over 300 feet; and as (*c*) the forward movement began not on August 17, but probably after the middle of September, when the river was much lower, the rate of advance was much faster and may easily have been 30 feet a day, as previously estimated.



THE BRIDGE WHICH IS MENACED BY THE ADVANCE OF CHILDS GLACIER (SEE PP. 541, 546) Photo by Lawrence Martin

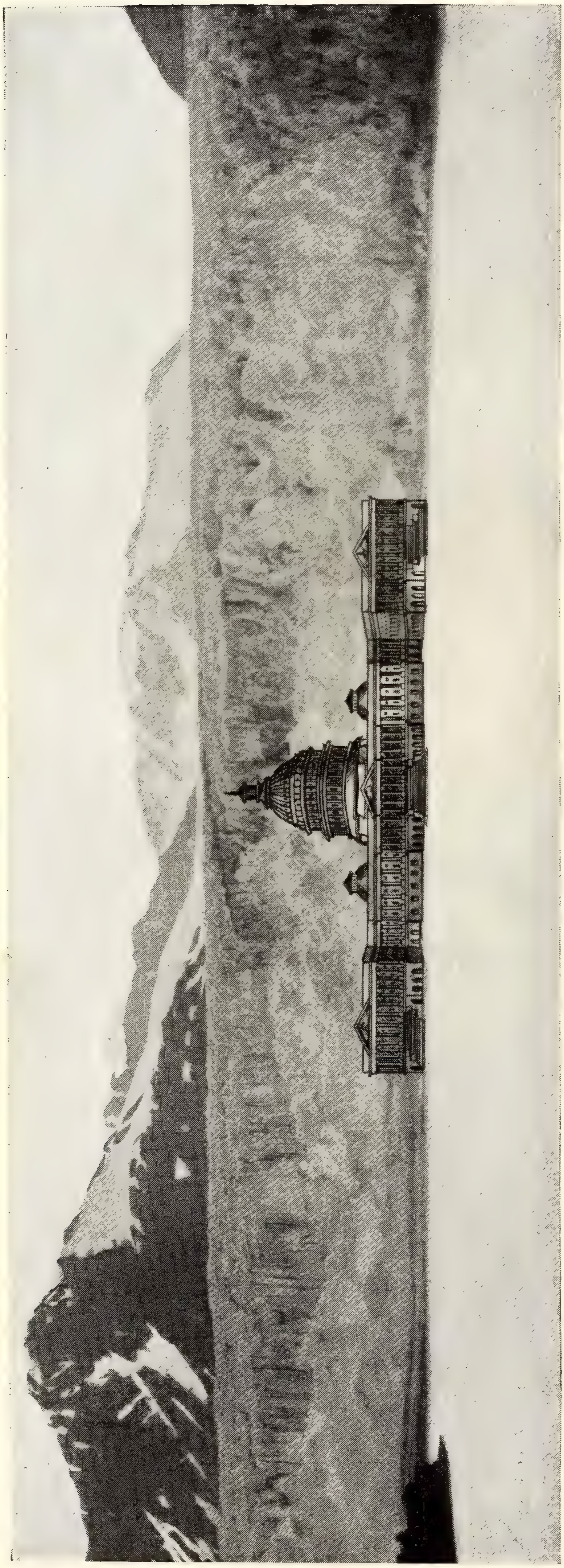


Photo by Lawrence Martin

PART OF FRONT OF CHILDS GLACIER IN COPPER RIVER

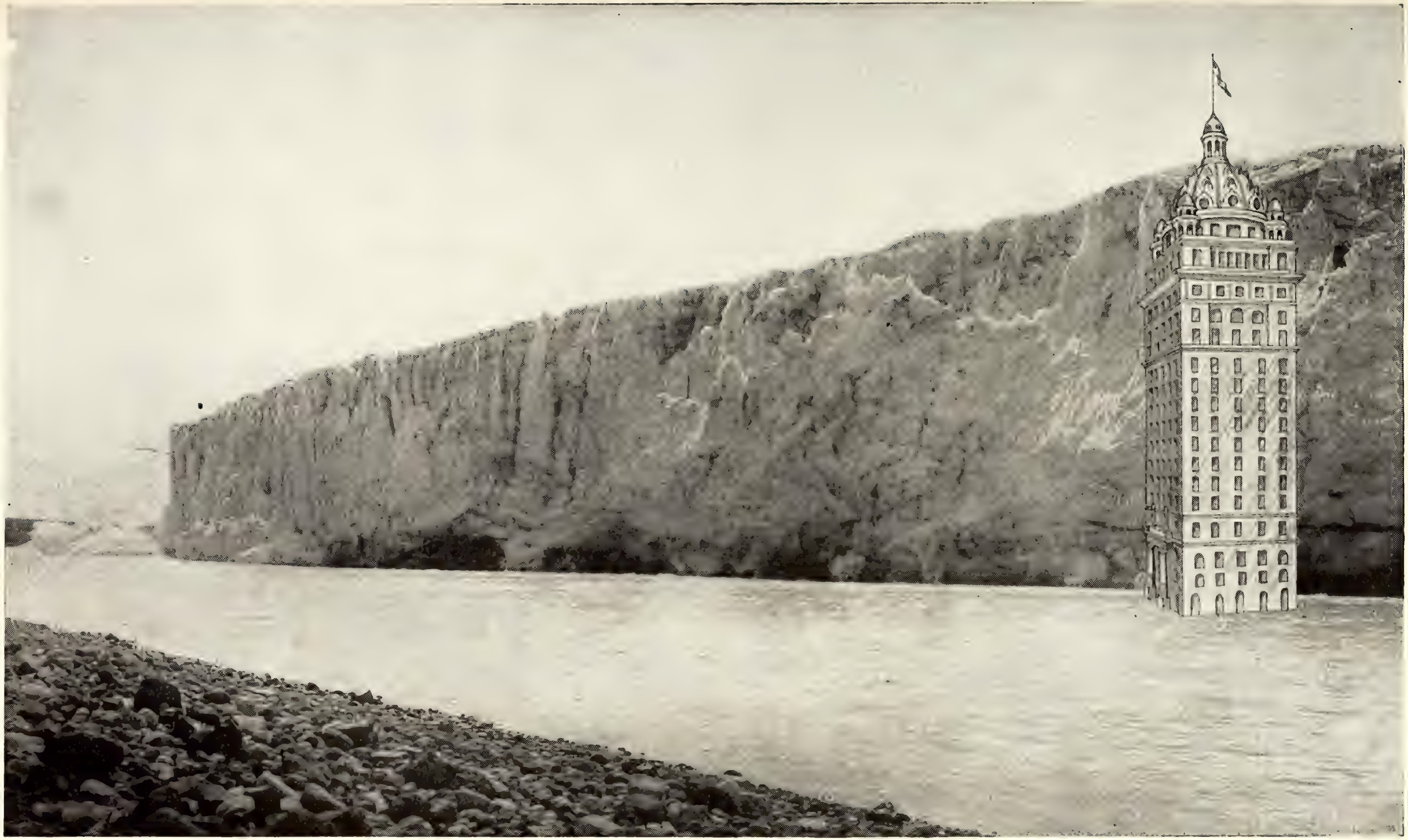
Showing comparison of ice cliff, which varies from 250 to 300 feet in height, with the Capitol, in Washington, which is 287½ feet high

What Childs Glacier is doing this year is of the greatest interest. It may continue to advance, or the diminishing rate of advance on the north margin after August 11 may suggest that the strongest advance is over. If advance continues, will the glacier move up to and destroy the railway bridge, which is only 1,575 feet distant from the north margin, or will it stop before getting there? The bridge cost $1,400,000 and is the key to the $20,000,000 railway to the copper mines.

It is absolutely certain that no corps of engineers living could save the bridge and railway if the glacier is destined to advance that far. We have seen Hidden Glacier, in Yakutat Bay, advance two miles, or over 10,000 feet, and bury a bench mark near the former terminus beneath 1,100 feet of ice, and Haenke Glacier advance over 5,000 feet in less than 10 months.

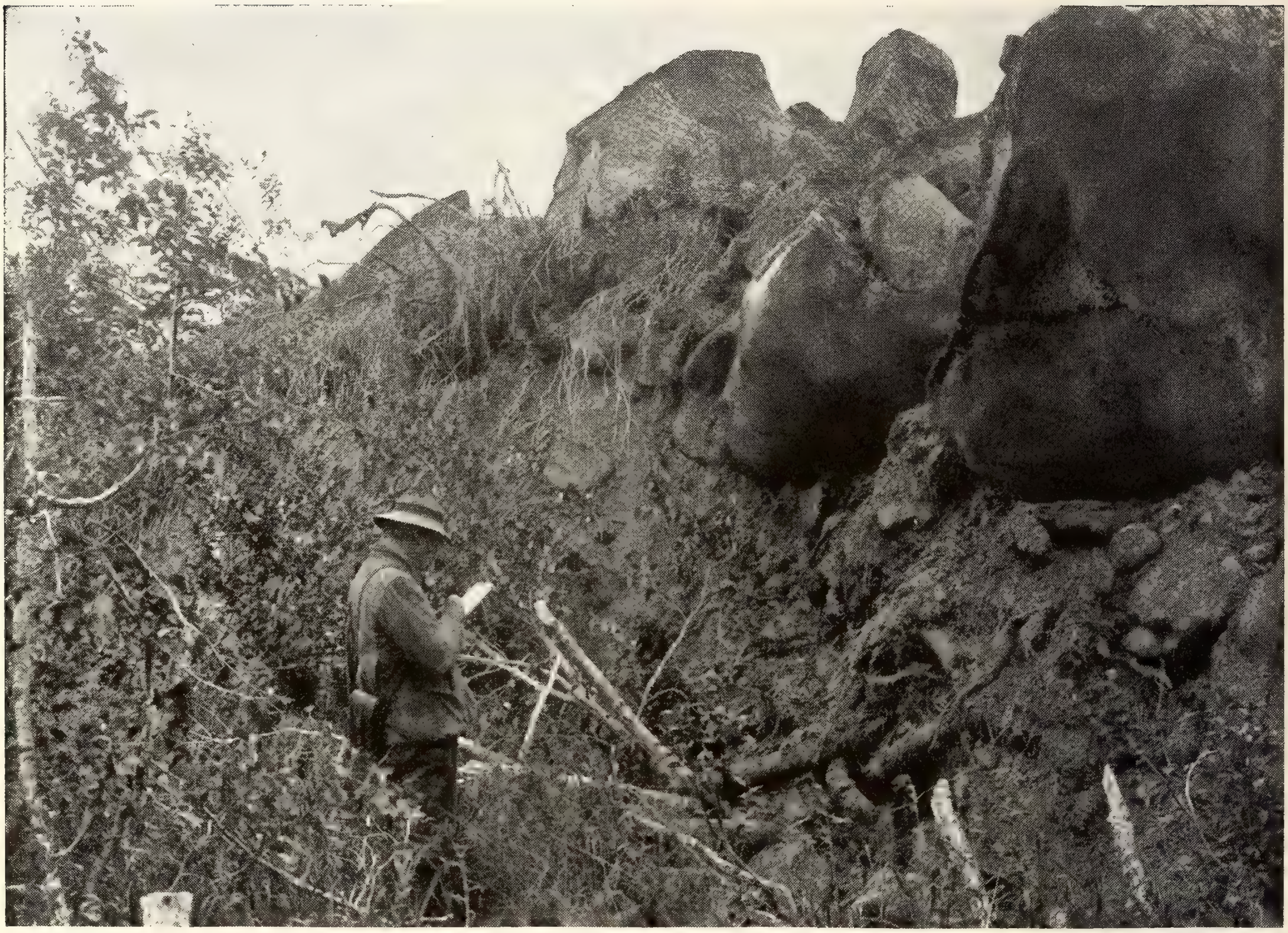
On August 11 the railway was about 4,500 feet from the middle of the glacier, which would easily have advanced this distance between May and October, if it is moving at the rate of 30 feet a day. If its front had not been swept by Copper River the rapidly moving middle of the glacier would pretty surely have advanced this distance, while the more slowly moving margin was advancing the observed 1,700-1,800 feet, at the rate which increased from practically zero in 1909 till it reached two to eight feet a day in 1910.

If the river had not had its normal summer rise of six feet or more the middle of the glacier would surely have advanced a good part of this distance, as it did advance 1,225 feet before the rise came, and as it may do this fall and win-



THE CLIFF OF CHILDS GLACIER COMPARED TO THE CLAUS SPRECKLES BUILDING, OF SAN FRANCISCO

The picture shows how the icebergs back off from it on the extreme left, where the Copper River undercuts the ice cliff, giving rise to a great water wave, which may be seen in the picture (see page 541). Photo by Lawrence Martin



THE ADVANCING TERMINUS OF CHILDS GLACIER, NEAR THE NORTH EDGE, IN AUGUST, 1910, WHEN THIS PORTION WAS ADVANCING ABOUT 3½ FEET A DAY

ter when the water is low and the river weak. It is evident, therefore, that the preservation of the railway bridge is due to the river, the very thing which necessitates the bridge.

It will be most interesting to see if the advance continues during the low-water stage from October, 1910, to May, 1911, with gradual forcing of the river eastward, the cutting back of the river bank in the unconsolidated gravels, the interference with stream flow and icebergs discharge from Miles Glacier, and many accessory phenomena.

Grinnell Glacier, a smaller ice tongue north of Childs, also began to advance between 1909 and 1910.

ADVANCING GLACIERS IN PRINCE WILLIAM SOUND

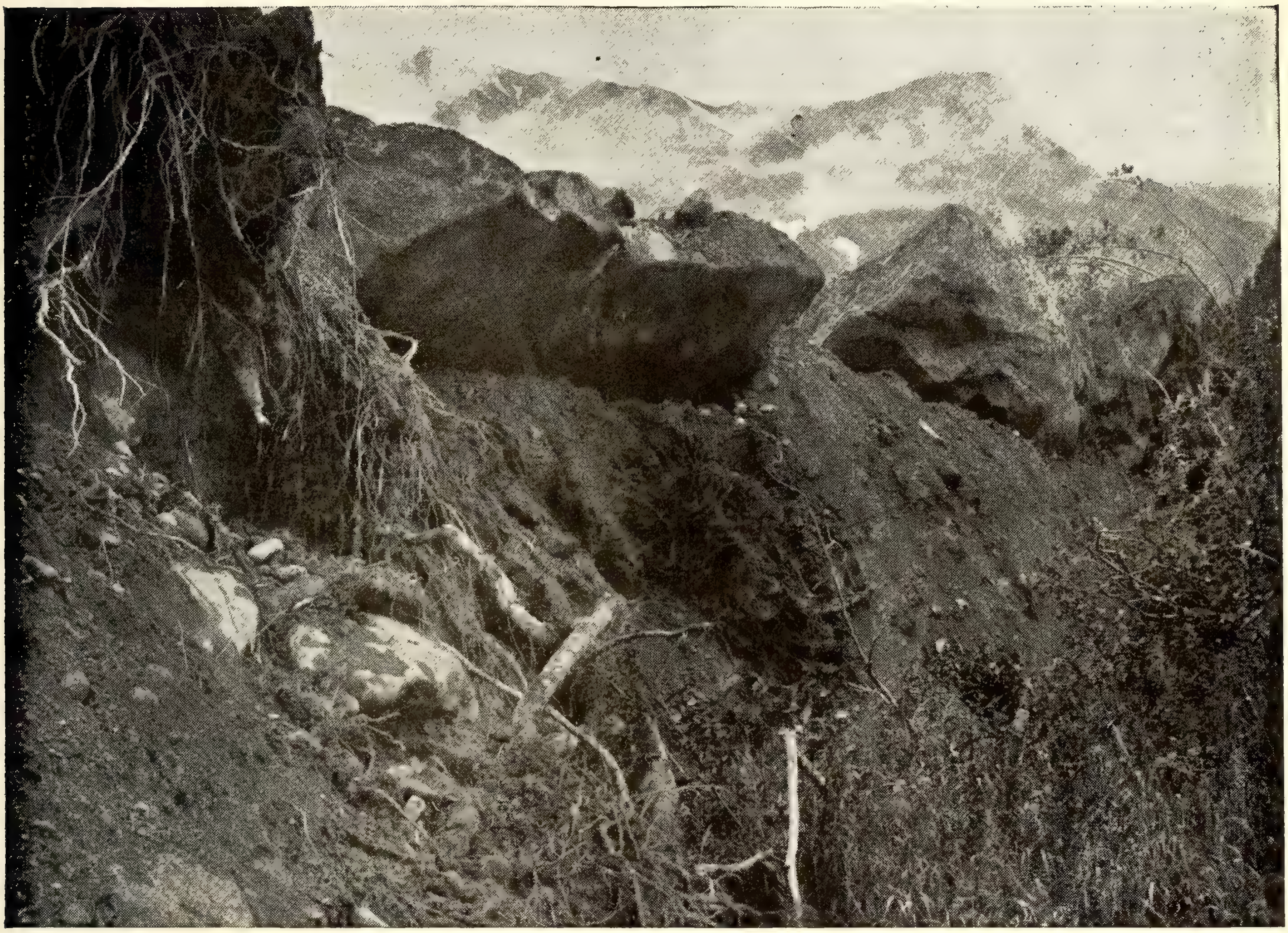
An unusually large number of glaciers in Prince William Sound were advancing in 1910. Of these the largest is Columbia Glacier. This ice tongue, west of Valdez, is three to four miles wide and 25 miles or more in length. It has two tidal fronts, separated by Heather Island, upon which the middle of the glacier terminates. It had its last important advance about 1892, as determined by G. K. Gilbert in 1899, and began the present advance during or just before 1908. This has progressed as follows, as observed by Prof. U. S. Grant and the National Geographic Society's 1909 expedition:

After July, 1905, to July 15, 1908, advance, 100 feet.

July 15, 1908, to June 24, 1909, advance, 310 feet.

June 24, 1909, to August 23, 1909, advance, 70 feet.

These observations are on Heather Island.



ANOTHER VIEW OF THE ADVANCING FRONT OF CHILDS GLACIER, NEAR THE NORTH EDGE, IN AUGUST, 1910, WHEN THIS PORTION WAS ADVANCING ABOUT 3½ FEET A DAY: THE GREAT BLOCKS ARE ICE

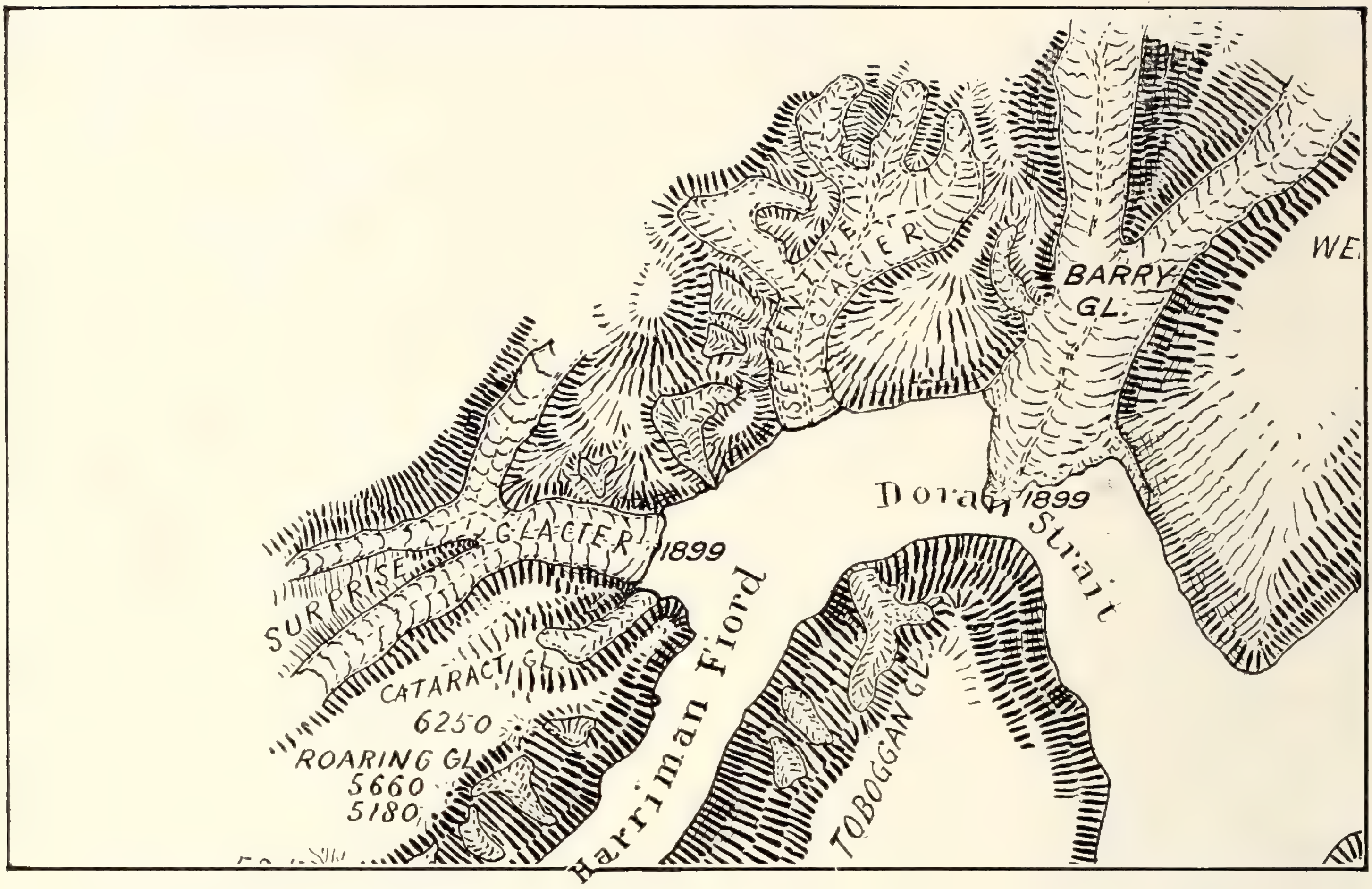
Between August, 1909, and June 30, 1910, when the Society's 1910 expedition returned to the region, the main ice cliff of Columbia Glacier west of the island had advanced over 600 feet, the advance upon the island being about 135 feet. From July 4 to September 5 the advance at the same point was 132 feet.

Columbia Glacier forms an interesting contrast with Childs, the rate of advance in the Childs increasing rapidly from 2.5 feet to 8.2 feet a day and decreasing again to .7 foot a day, all in four months, while the Columbia has slowly increased its rate of motion for two years from .9 foot a day in 1908 to 2.1 feet a day in 1910.

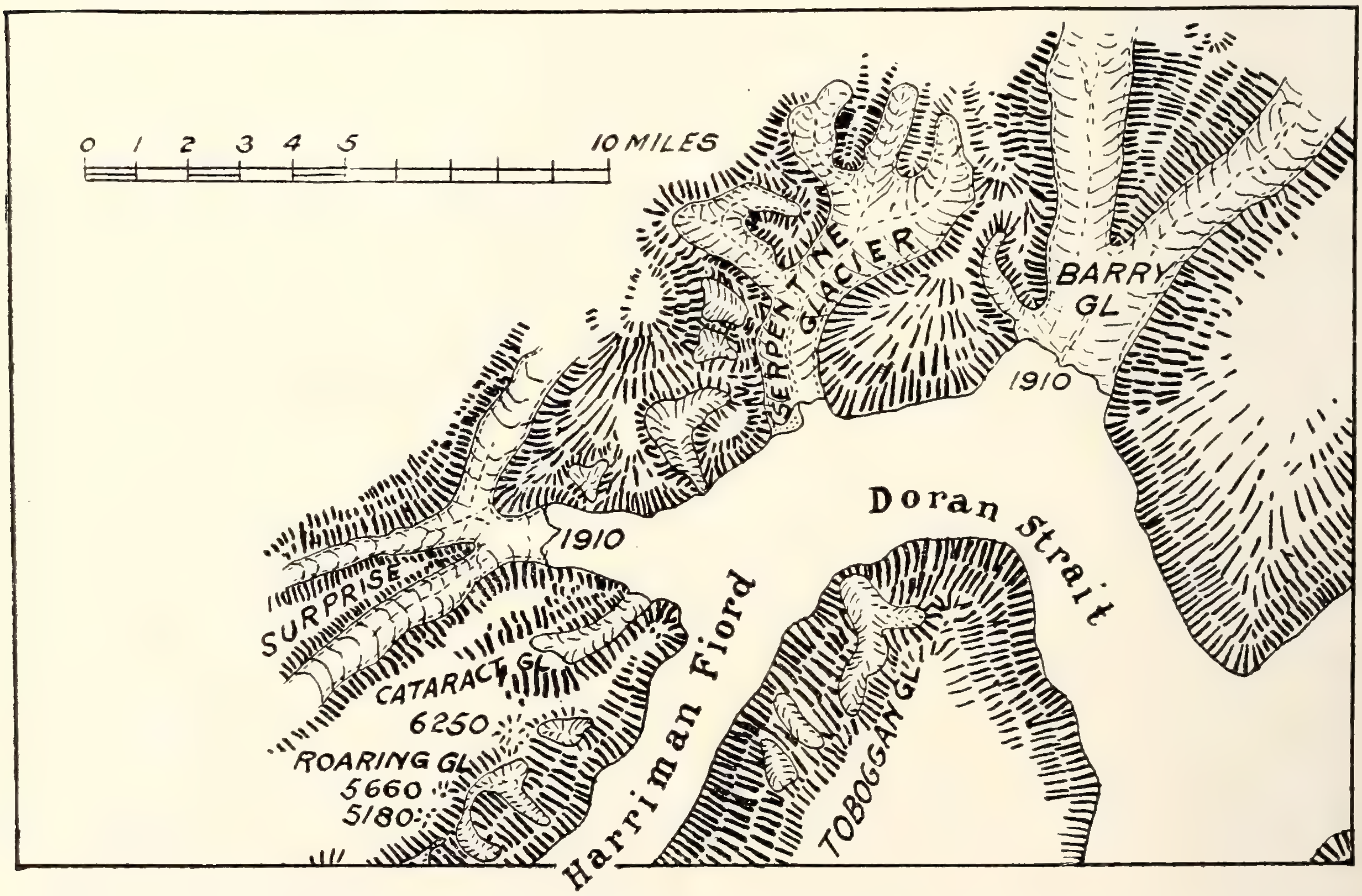
The phenomena accompanying this advance during the summer of 1910 were of great interest. The glacier was advancing into forests at its borders and on Heather Island, as in 1909, and overturning mature evergreen trees, which had grown undisturbed for a century or more, the advance having exceeded the 1892 maximum.

A whole grove on the west edge of Heather Island was overturned between 1909 and 1910, on our last visit, in September, practically not a tree remaining which was not overturned or leaning. Peat bogs were rolled up in great bolsters five or six feet high. Isolated trees in the peat were pushed forward a hundred feet or more without being overturned. A push moraine 15 to 25 feet high faces the ice front, the material being, variably, beach gravel, glacial till, mud flows, peaty soil, and macerated heaps of tree trunks and roots. In the bay east of Heather Island marine deposits with shells are being pushed up above sea-level.

On the east margin of the glacier a



SKETCH OF PORT WELLS, PRINCE WILLIAM SOUND, ALASKA, IN 1899



SKETCH OF PORT WELLS IN 1910, SHOWING THE EXTRAORDINARY RETREAT OF BARRY AND SURPRISE GLACIERS (SEE PAGE 551) lake was formed where there was only a marginal stream in 1909. At the outlet of this lake the turf covering the glacial deposits, which were being pushed forward by the advancing glacier, was gashed with irregular cracks where the former covering of the soil had proved too small to fit the bulging hill. Between June and September, 1910, when we revisited Columbia Glacier, the waterfall at the lower end of this lake was cut back, the lake level was lowered a little, and the stream-course shifted.

As at Childs Glacier, the advance was not spectacular, and noises were absent. One could clamber all over the advancing margin of the glacier. From one day to the next, however, we saw great changes, as when a part of the ice front was seven feet from a blazed tree on July 6 and touched the tree on July 9.

From July to September the changes were far more noticeable, the most spectacular transformation being the decrease in height of a portion of the glacier from about 60 feet to less than 15 feet, while its margin in the same place advanced. If this was due to melting it was at the rate of nine inches a day, taken off by vertical ablation. The measured rates of surface melting on other glaciers in Alaska are one, two, four, and seven inches a day, all on retreating glaciers. As the terminus of the glacier was advancing, we think it probable that there may have been a collapse of this portion of the glacier surface by the moving away of the ice beneath—a phenomenon exceedingly suggestive of viscous flowage.

West of Columbia Glacier in Unakwik Inlet is Meares Glacier, the north side of which advanced slightly between 1909 and 1910. This is the glacier which the Spanish explorer Fidalgo, in 1790, called a volcano, because of the discharge of icebergs from below sea-level with thundering reports. Above it rises Mount Grosvenor, named for the National Geographic Society's Director and Editor.

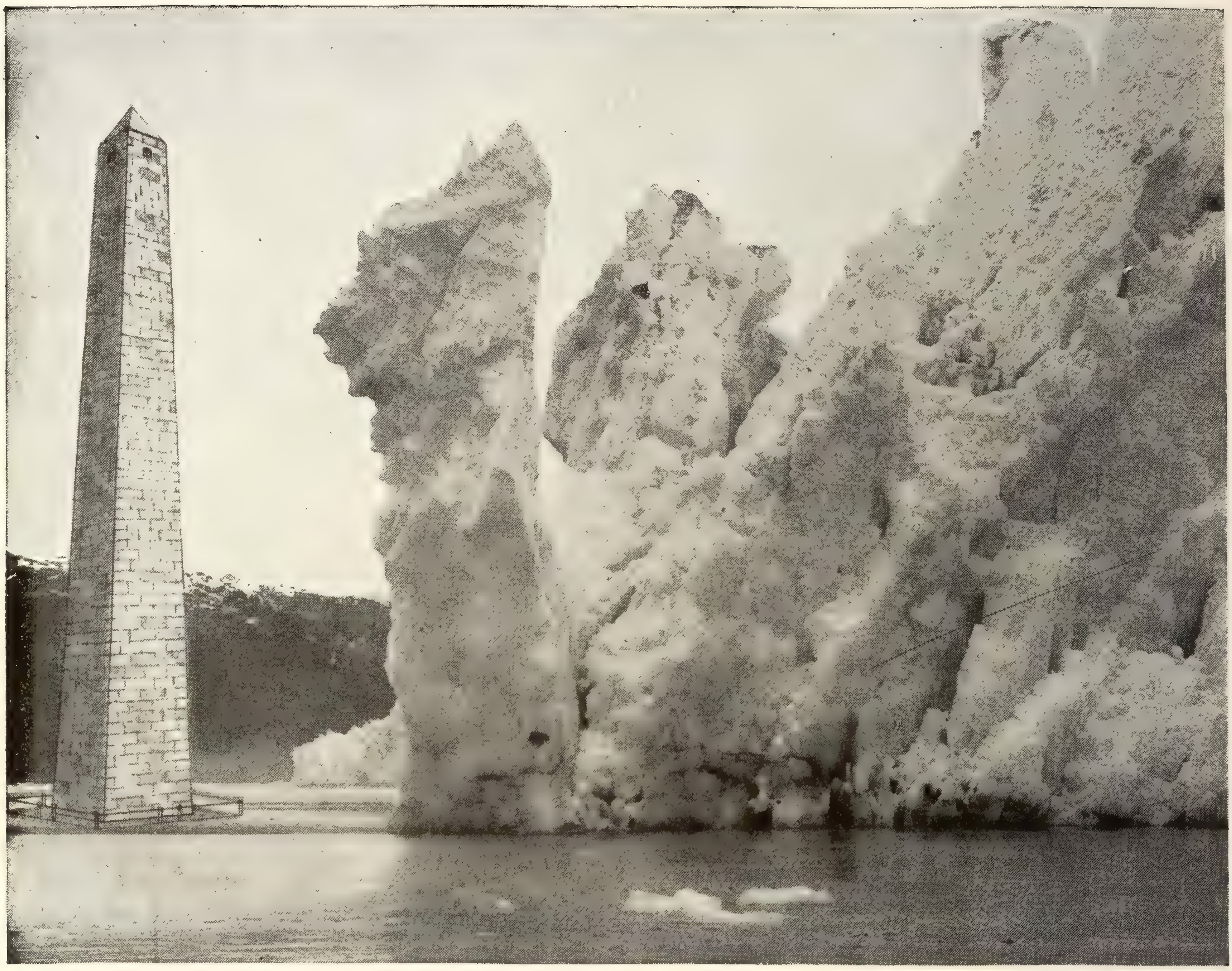
In the northwest corner of Prince William Sound is Port Wells, a broad fiord whose branches—College Fiord, Harriman Fiord, and Passage Canal—contain large glaciers. In College Fiord seven glaciers were advancing simultaneously in 1910, two of them perhaps commencing in 1909, as observed by Grant. The Harvard, Yale, Radcliffe, Smith, Bryn Mawr, and Wellesley glaciers displayed activities similar to that of Childs and Columbia glaciers, after having been stagnant for a long time before. Yale Glacier had advanced 750 feet in all since 1899, when it was studied by the Harriman expedition and mapped by Gannett. All these glaciers were destroying the forests at and upon their margins, and splinters of ice were being pushed forward by faulting, as at Columbia Glacier.

Harriman Glacier was the only one in the fiord of that name which was advancing in 1910, having come forward 300 feet since 1899. In Blackstone Bay, a branch of Passage Canal, several of the glaciers are advancing.

RETREATING GLACIERS

Below Mount Gannett in Harriman Fiord is the Barry Glacier, which nearly separated that body of water from the sea in 1899, when the Harriman expedition discovered and explored it. Between 1899 and 1910 Barry Glacier retreated about 3½ miles, as is shown on page 550, where Gannett's map is reproduced with the latest one. Approximately 600 feet of this retreat took place between Grant's visit in 1909 and ours a year later. Moraine-veneered ice was still present in 1910 on the site of the margin of the glacier in 1899, over two miles from the present ice front. Surprise Glacier went back a mile and a quarter in this same period of 11 years.

Tiger Glacier in Icy Bay was shortened about seven miles between 1794, when Vancouver's lieutenant, Whidbey, mapped it, and our visit in 1910. Not only has the fiord been lengthened by this amount, but the Icy Bay glacier of 1794 has been dismembered into the Tiger, Chenega, and Princeton glaciers. Valdez and Shoup glaciers had retreated slightly since 1909. Nellie Juan Glacier was little changed. Many other glaciers



FRONT OF COLUMBIA GLACIER IN 1910, COMPARED IN HEIGHT TO BUNKER HILL MONUMENT

The ice pinnacle, rising over 200 feet above the base, fell a few minutes after this picture was taken. Photo by Lawrence Martin

had retreated small amounts since visited by earlier parties, and a number seemed to have maintained their positions.

REASONS FOR OSCILLATIONS OF GLACIERS

It is not perfectly clear why these glaciers in Prince William Sound and on Copper River are oscillating—some advancing and some retreating. Of course the fundamental cause is involved with snow supply and with rate of melting as determined by temperature. Climatic records are so incomplete that we cannot settle this question. On the other hand, it is possible that the snow supply of any glacier or group of ice tongues might have been increased by avalanching during earthquakes, as is the case in Yakutat Bay, rather than by increase of precipitation. These Prince William Sound and Copper River glaciers are outside the zone affected by great avalanching during the Yakutat Bay earthquakes of September, 1899, though the advance of La Perouse Glacier may possibly be due to that seismic disturbance. There are many other earthquakes, however, whose origins were in or near the region of these advancing glaciers, and one such in October, 1900, was of considerable intensity.

The Yakutat Bay glaciers which have so far advanced as a result of the earthquakes, including Nunatak Glacier, in 1910, are of variable sizes and have responded in order of size, the smaller ones first. These advancing glaciers in Prince William Sound are also of vari-

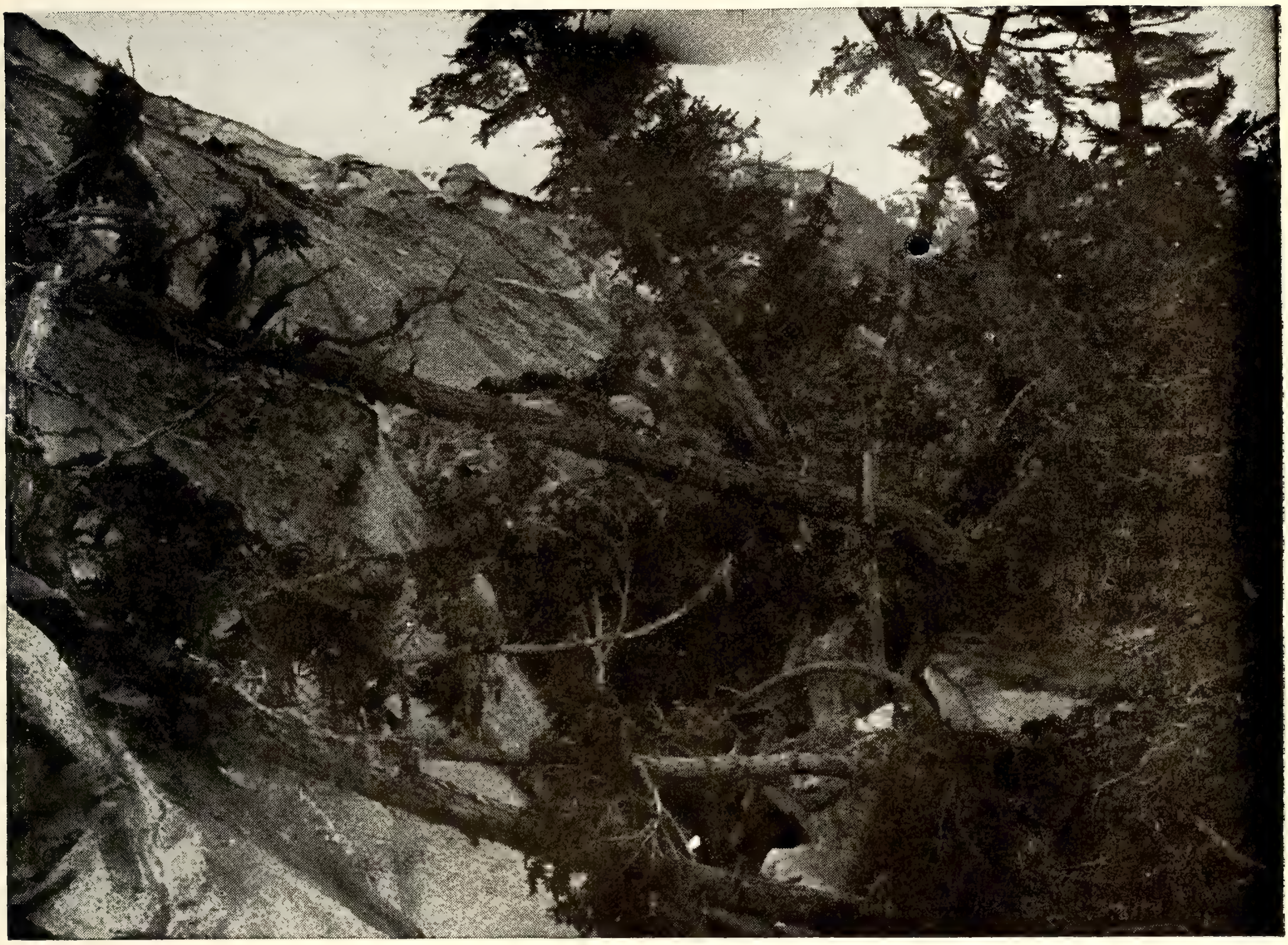


Photo by Lawrence Martin

COLUMBIA GLACIER OVERRIDING A FOREST (SEE PAGE 549)

able sizes, and the largest, Columbia and Valdez, seem to have begun to advance in 1907-'08, before the smaller ones of College Fiord, where seven ice tongues—the large Yale and Harvard, and the smaller Wellesley, Vassar, and others—all began to advance together in 1909-'10.

This absence of relation between size and period of advance and the lack of spasmodic transformation to activity, with rapid return to stagnation observed in Yakutat Bay, suggests that the advances now in progress may be climatic. An increase in precipitation at Valdez from 56 inches in 1904 to 91 inches in 1907, and back to 70 inches in 1909, supports this hypothesis, though we do not feel at all sure that the increase was more than local, for such great variations are common in Alaska and are usually not widespread.

The only satisfactory course for the present is to ascribe the great awakening of certain of these glaciers either to climatic variations or to earthquakes, and then wait to see whether the other glaciers, now retreating, also advance, and whether those now advancing behave as have the Columbia Glacier and certain advancing glaciers in the Alps, suggesting a climatic explanation, or whether they develop the characteristics of the earthquake-stimulated Yakutat Bay glaciers, as the Childs Glacier seems possibly to be doing. It would be most desirable if some one could revisit these glaciers in a year or two to obtain evidence bearing on this question.

OLDER ADVANCES DUE POSSIBLY TO EARTHQUAKES

I studied the previous history of a group of glaciers in Harriman Fiord carefully, and it furnishes clear evidence of two previous periods of advance. The best evidence comes from the Barry,

Photo by Lawrence Martin

NORTH SIDE OF SMITH GLACIER, SO NAMED IN HONOR OF SMITH COLLEGE

Serpentine, Toboggan, and Baker glaciers, all of which are now retreating.

Around the termini and lower borders of a number of the Prince William Sound glaciers are conspicuous barren zones, where the glaciers have melted back from their farthest recent advance. There was such a barren zone around Columbia Glacier in 1899 when Gilbert visited it, but before 1909 most of this barren zone was overridden by the advancing glacier, and in 1910 it was all covered, as were parts or all of the barren zones bordering the College Fiord glaciers in 1899 and 1909. In Harriman Fiord these barren zones are still present near most of the glaciers. My first impression was that the advances preceding the retreats that exposed these barren zones were synchronous, and that an examination of the ages of shrubs that had sprung up in the barren zones would reveal the approximate date at which the last advance of these glaciers had taken place.

Serpentine Glacier was studied first, and in its barren zone the scattered willows, alders, and spruces were none of them more than 27 years old. An earlier moraine outside this had trees up to 93 years of age. Baker Glacier, just south of Serpentine, had a nearly barren inner moraine with shrubs 18 years old, and a more thickly forested outer moraine with spruces up to 110 years old. Toboggan Glacier, near by, has 20-year-old shrubs on the last moraine of its barren zone and conifers of 70 years' growth on an older moraine.

Many trees were cut down in determining these ages, the oldest ones being cited here.

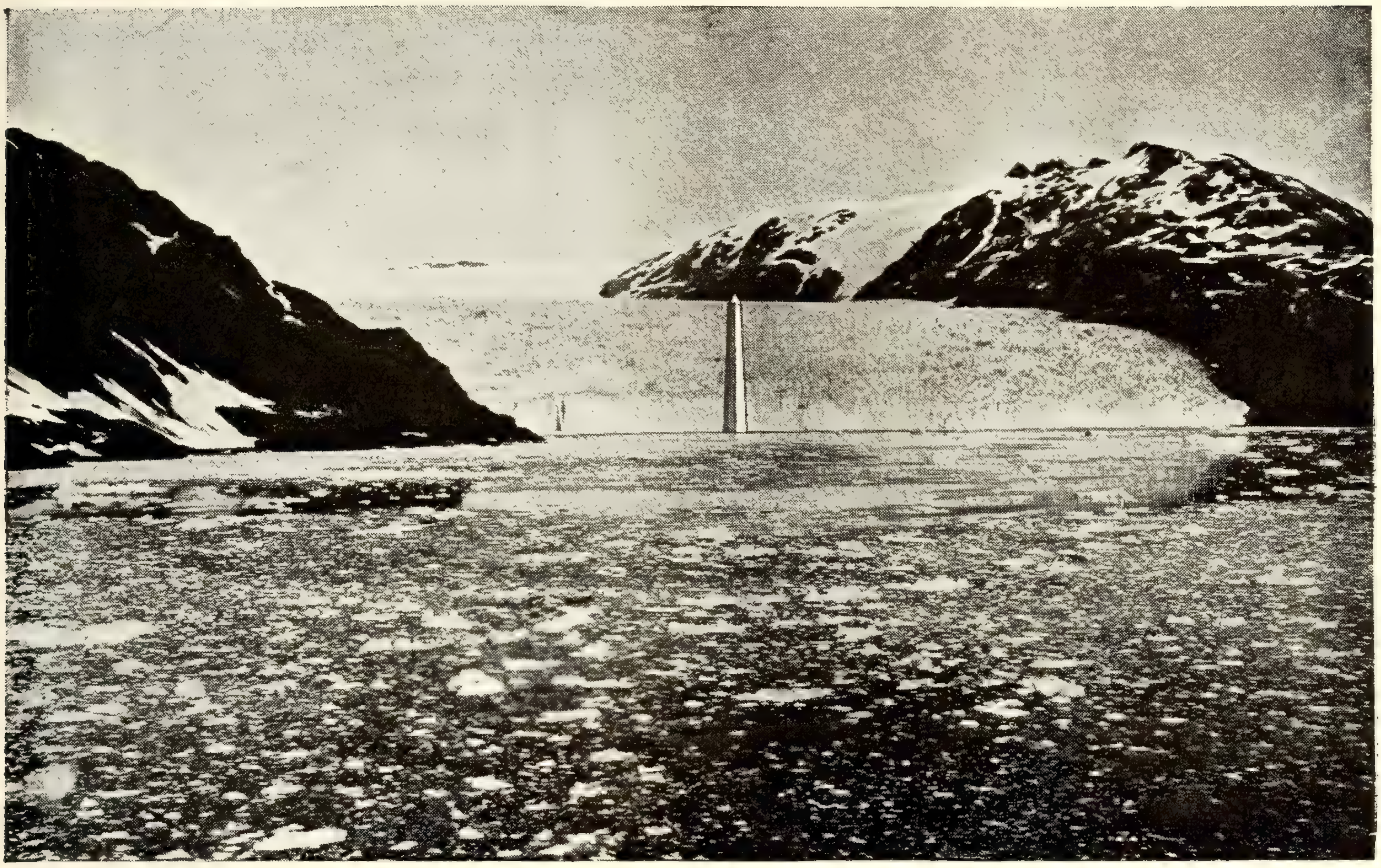


Photo by Lawrence Martin

THE TERMINAL ICE CASCADE OF CHENEGA GLACIER, ICY BAY, WHICH IS ABOUT 550 FEET HIGH, COMPARED GRAPHICALLY WITH THE WASHINGTON MONUMENT

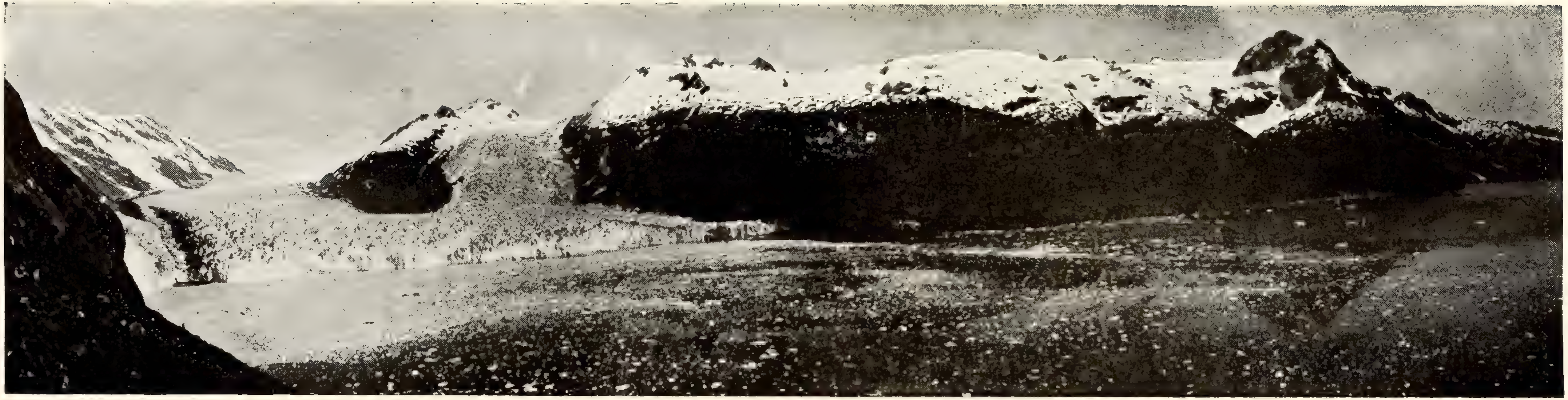
At the borders of these older deposits there are usually moraine ridges, beyond which is thick-set, mature forest with trees from 100 to 225 years or more of age. Barry Glacier is bordered by a barren zone with the oldest shrubs only 11 years old, and there are not two belts, but one, outside which a very perfect push-moraine ridge on each side of the glacier separates the barren zone from the thick forest.

I had found, therefore, that the advances were not synchronous, and that in three cases out of the four the glacier had advanced twice, for it is hardly conceivable that each glacier stood at the inner moraine while the shrubs grew for 50, 66, and 92 years. The data for the last of these two advances may be arranged as follows, suggesting glacial maxima in the years shown in the right-hand column, if we assume that retreat began as soon as the glacial maximum was reached in each case:

Glacier.	Age of trees.	Possible date of advance.
Serpentine..........	27 years....	1882
Toboggan...........	20 years....	1889
Baker	18 years....	1891
Barry...............	11 years....	1898

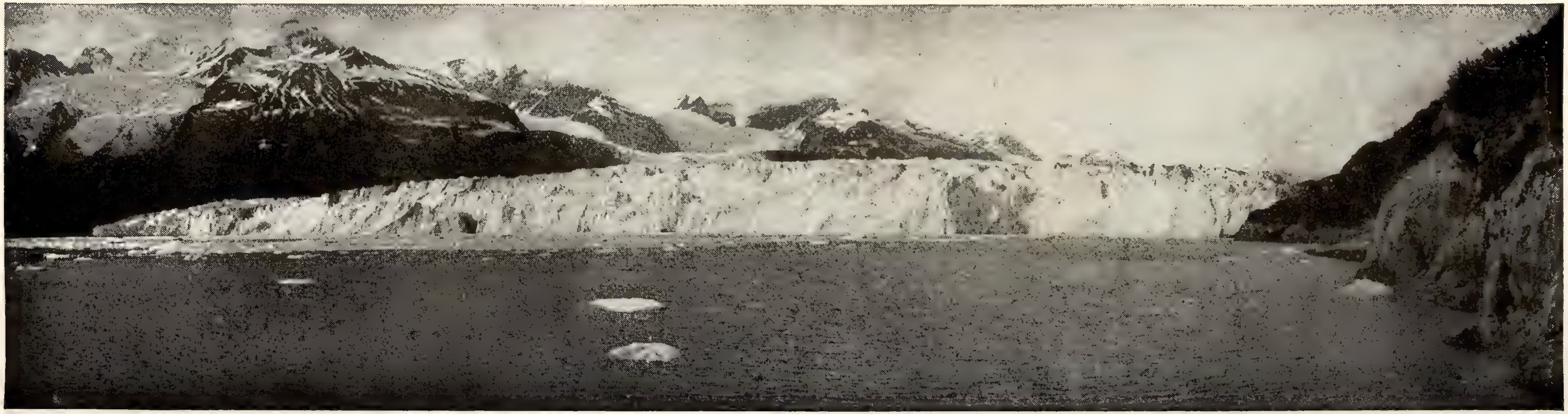
There are no known visits of white men by which to check any of these dates, except in the case of the Barry Glacier, which had retreated slightly from the edge of the barren zone when the Harriman expedition visited it in 1899. In 1898 some army officers saw it from a distance and the advance had already taken place, but they were not near enough to see whether it was still advancing.

This group of advances, 11-27 years ago, may possibly be due either to climatic variations or to earthquake avalanches. If it was the former, we must explain why all these glaciers, which are fed from adjoining snow-fields, did not advance approximately together instead



PANORAMA OF BARRY GLACIER AND MOUNT GANNETT, 9,240 FEET

Named for the President of the National Geographic Society, who in 1899 first mapped the Barry Glacier



Photos by Lawrence Martin

HARVARD GLACIER FROM SHORE NORTH OF COLLEGE POINT: NONE OF THESE GLACIER ENDS ARE AFLOAT (SEE PAGE 558)

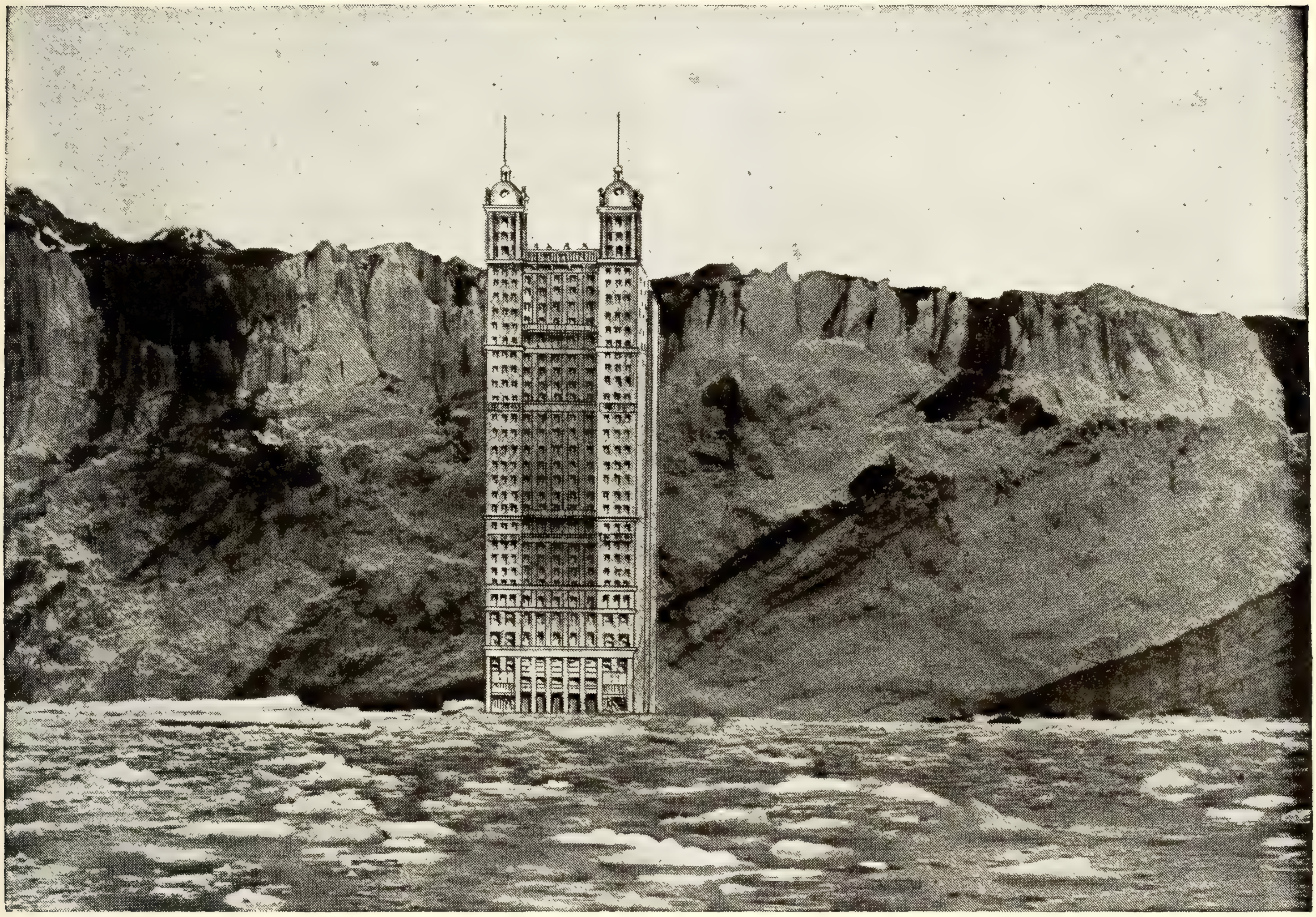


Photo by Lawrence Martin

THE TERMINAL ICE CLIFF OF HARVARD GLACIER, COLLEGE FIORD, 350 FEET HIGH, COMPARED IN HEIGHT WITH THE PARK ROW BUILDING, NEW YORK CITY, WHICH IS 390 FEET HIGH

of through a period of 16 years; but we know too little about the sizes, shapes, and slopes of the snow-fields to raise this as a valid objection.

If earthquake avalanching is thought to have caused the advances, we see the likeness to the Yakutat Bay glaciers at once, for Barry Glacier is longer than Serpentine and Baker than Toboggan. The two last are shorter than Serpentine, but have very different grades. There was a severe earthquake in 1880, and the advances show an apparent time relationship to this that warrants the retention of this hypothesis as possible. It would be most valuable if we knew whether these advances were abrupt, like the earthquake-stimulated Yakutat Bay advances, or not, and how long they lasted.

In the case of the group of still earlier advances, the short Baker Glacier advanced before the longer Serpentine, with the Toboggan Glacier still later. The absence of a record for Barry Glacier suggests that the 1898 maximum went beyond this earlier one and destroyed the records of it, as Columbia Glacier has now destroyed practically all the evidence of the 1892 maximum, which was plainly visible from 1899 to 1909. The only safe conclusion regarding the two sets of advances, 11-27 and 70-110, years ago, is that the progressive development of advances in adjacent glaciers of several sizes suggests the possibility of an earthquake origin, just as the synchronous advance of the seven, variable sized, contiguous, College Fiord glaciers in 1910 suggests the possibility of climatic origin.

SUBMARINE TOPOGRAPHY

The map reproduced on page 559 illustrates the results of a typical day's

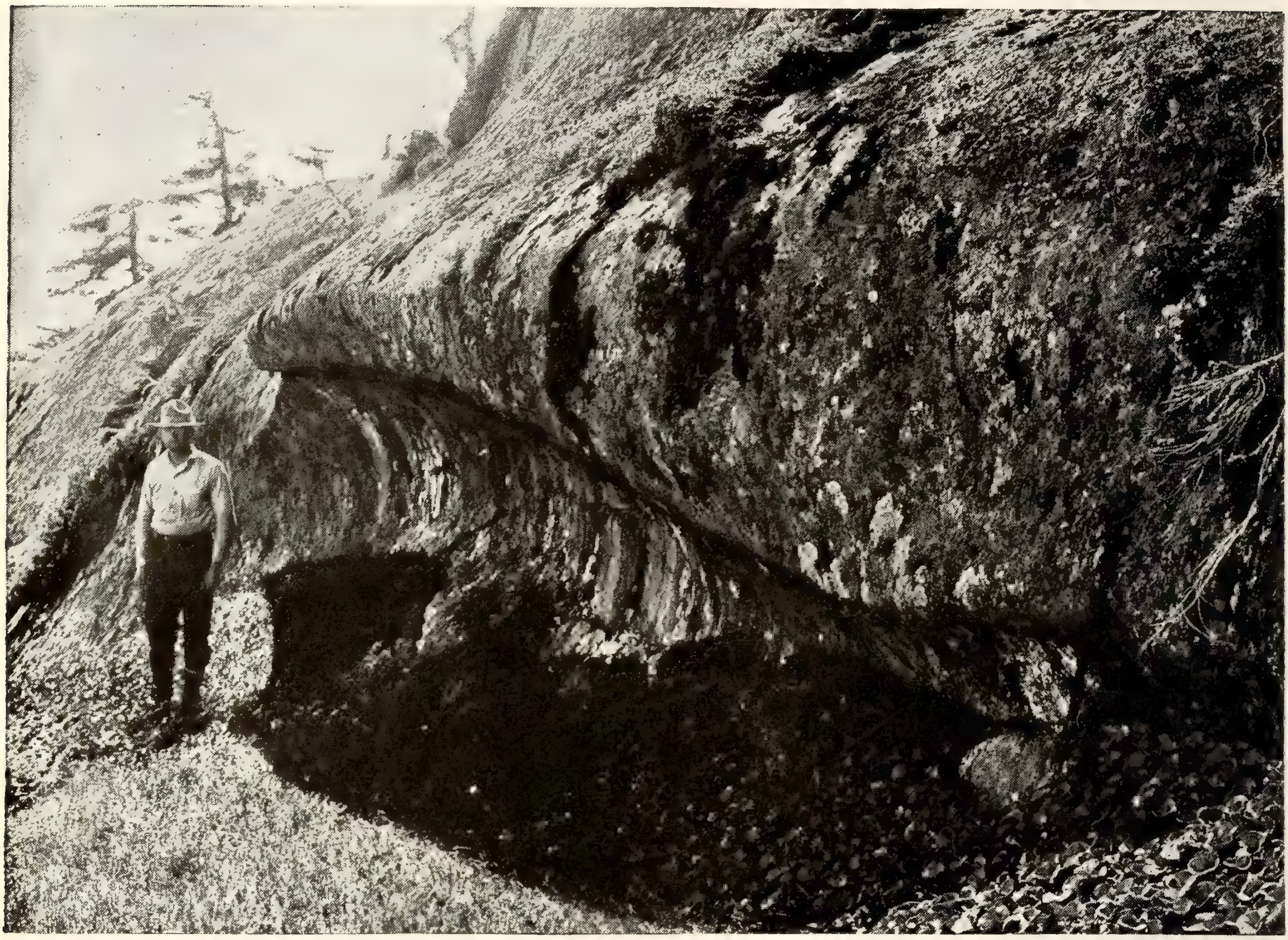


Photo by Lawrence Martin

A GREAT GROOVE CUT IN HARD ROCK BY A GLACIER AS IT ADVANCED: PORT DORAN, HARRIMAN FIORD

work in the study of the submarine topography produced by glacial sculpture and deposited in a fiord. On that particular day we made only 29 soundings, but most of them were deep ones and one of the party calculated that we had wound up five miles of wire during the day.

As we looked up at Mt. Gilbert, 10,194 feet, on the way to camp that night, we imagined an equal mountain placed on top of it and over half a third one, thinking what it would have meant if we had been on top of such a 26,000-foot peak with a 20-pound lead at the base and had had to wind it up with our small hand reel all at once instead of in 500-1,400 foot lengths. Then the day's work seemed larger, especially as we had discovered an invisible moraine below sea-level, together with two submerged hanging valleys, and had located an uncharted rock and made a 22-mile longitudinal section and two cross-sections of a wonderful glacially sculptured fiord.

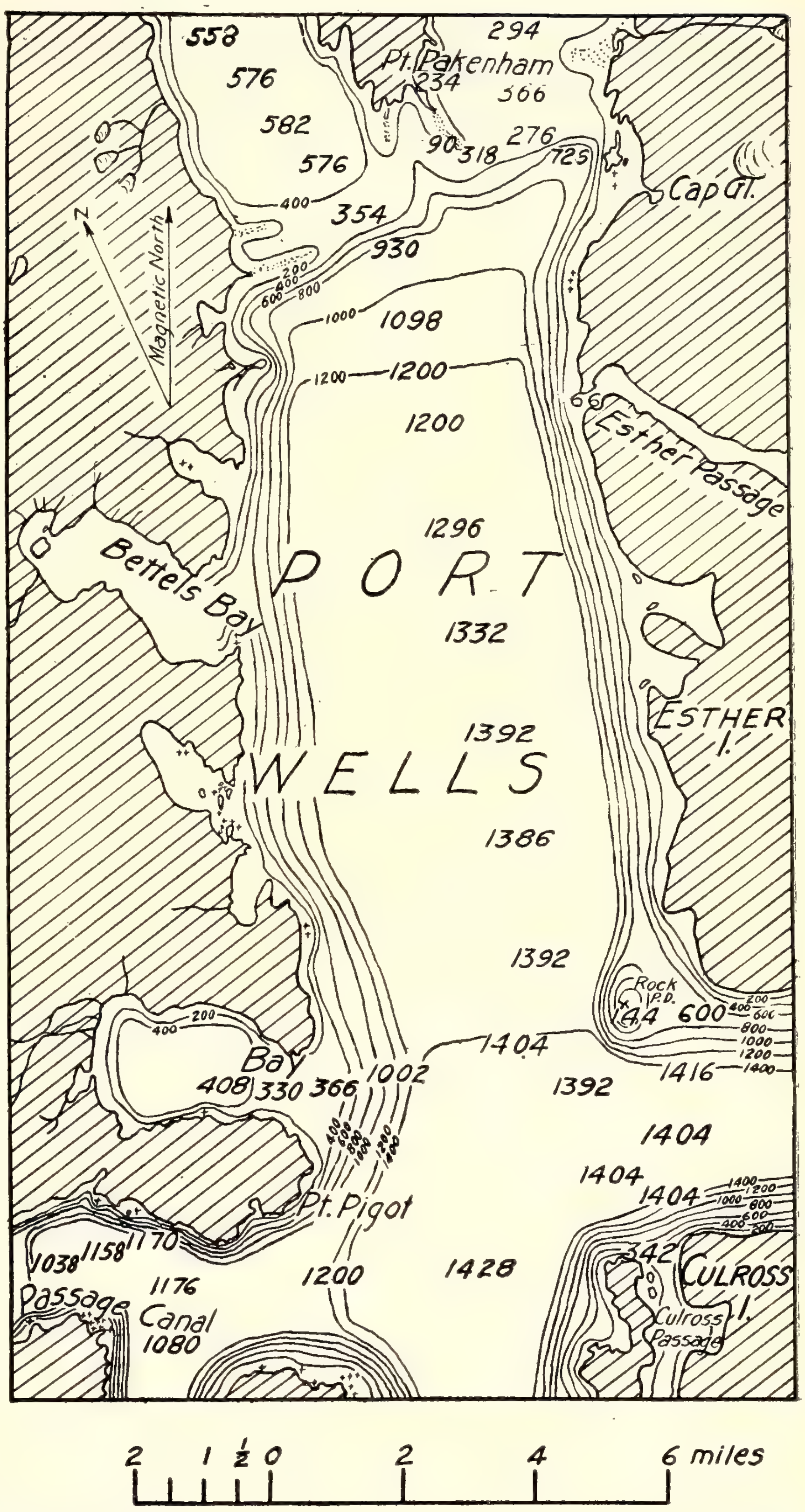
Our other soundings revealed similar groups of results. The depths of water, as near the fronts of the several large tidal glaciers studied as we dared venture in our launch, varied from 90 feet in the case of Harriman Glacier to 636, 600, and 555 feet near Harvard, Columbia, and Nunatak glaciers, respectively. This shows that none of these glacier ends could be afloat, for the visible 200-300-foot ice cliff, if floating, would have six or seven times that depth below sea-level, and in no case is the part of the fiord near the glacier deep enough.

We made many other longitudinal and cross-sections of inlets in Prince William Sound and Yakutat Bay, finding them all of such form as to support our belief that all these fiords have been chiefly widened and deepened by glacial erosion. The submarine topography in each case was not greatly different from that above sea-level. Some rock basins were also eroded in the fiord bottoms, but these and the submerged moraines are hard to distinguish by soundings alone.

Many other submerged hanging valleys were discovered in soundings, as Granite Cove and the channel east of Heather Island, near Columbia Glacier; Siwash Bay, in Unakwik Inlet; Yale Arm of College Fiord; the cove near Tebenkof Glacier, in Blackstone Bay; the cove of Serpentine Glacier, in Harriman Fiord; Nunatak Fiord, Seal Bay, and the channel east of Haenke Island, in Yakutat Bay, and many others.

The submerged moraines which we found were of three types. The first type is the moraine bar, rising nearly to or just above sea-level, and like the familiar sand bar or pair of spits, except that it is made up of angular striated boulders of various sizes instead of pebbles and sand. It differs from the recessional moraine on the land, too, in having most of the clay in its till washed away by the tides. Such moraine bars are found in Unakwik Inlet and Blackstone Bay.

The second type of moraines is partly revealed without sounding and may be deeply submerged in the middle, but with normal sand pits growing upon the moraines near shore, as at the mouths of College Fiord and Barry Arm. These moraines may also have their positions suggested by irregular shoals or by the stranding of icebergs, as on the sites where Barry and Nunatak glaciers stood in 1899.



MAP SHOWING SOUNDINGS IN PORT WELLS, PRINCE WILLIAM SOUND

Illustrating a typical day's work in the study of submarine topography (see page 558)

The third type of submerged moraine is entirely unsuspected until revealed by sounding, as in College Fiord, opposite Smith and Bryn Mawr glaciers. It was gratifying to find such a submerged moraine in lower Russell Fiord in 1910 exactly where we had previously postulated a halt of the ice because of overridden glacial deposits to the north and abandoned glacial lake shore lines to the south.

The nature of the glacial deposits accumulating now in shallow water is easy to see, as in Russell Fiord, near Yakutat, where the sands and clays of Hidden Glacier delta have grown forward 1,600 feet between 1899 and 1910, and in Harriman Fiord, where one can land at low tide on the till and boulder moraine shoals which were being built by Barry Glacier only 11 years ago, when the Harriman expedition was here. In more profound depths we know less about these deposits, except that they must be mostly muds and clays in these deep waters, with scattered stones dropped by floating icebergs. There are many other illustrations of each of the glacial features cited above, but the ones mentioned here must suffice as samples until the complete book on our glacial studies is published.

THE GLACIERS ARE REMNANTS OF GIANT PREDECESSORS

In Prince William Sound a few points stand out clearly in connection with the former great glaciers that flooded this arm of the sea when the existing glaciers were much more expanded. It is clear that they filled the whole sound, rising up in the present fiords high above the level of the existing glaciers, perhaps 4,000 feet above sea-level near Columbia Glacier and Port Wells. They did not cover all of Hinchinbrook and Montague islands, at the entrance of the sound, and these mountainous islands are largely driftless, as we proved by observations there, and formerly rose as nunataks through a piedmont glacier that extended out, as Malaspina Glacier does now, and probably reached Middleton Island, 55 miles offshore, ending in the Pacific with a great tidal ice front similar to the great snow barriers of the Antarctic region.

The existing glaciers are shrunken remnants of their great predecessors, and are largest near the highest mountains and greatest snowfields and very small in the lower regions, as on Knight and Montague islands.

The expanded glaciers eroded deeply, rounding the overridden islands in the north part and sculpturing the whole sound, which is 1,500 to 2,400 feet deep in some of the inner stretches and 1,200 to 1,300 feet deep in Hinchinbrook entrance, where the ice was constricted and moved rapidly, while the adjacent sea bottom of the Pacific is shallow, 200 to 300 feet, for over 50 miles offshore. Glacial deposits above sea-level are thin and scattered in Prince William Sound. The great work of the ice was erosion, with deposition mainly offshore. Dense mature forests extend up close to the present ice fronts, and there has been no episode of recent great expansion of glaciers, as in Yakutat Bay, though minor oscillations have, and still are, taking place.

The Copper River glaciers were also greatly expanded in the past and modified the valley profoundly. There is reason for thinking that the former great glaciers of the Wrangell Mountains and Alaska Range did not find an outlet down this valley, though much of the drainage may have come this way. Mr. Alfred H. Brooks, of the Geological Survey, had called my attention to peculiarities of this drainage, and I am inclined to think, after a brief journey up the Copper River to the mouth of the Chitnia, that the present course of Copper River across the Chugach coast range is entirely due to glacial modifications in a way to be explained in the forthcoming book.

The glacier studies in 1910 carry the previous researches by the National Geographic Society much farther than in 1909, supplementing the facts already established in Yakutat Bay, and their interpretation, and adding new data of considerable importance in glacialogy.

ACKNOWLEDGMENTS

THE National Geographic Society has much pleasure in expressing its thanks and appreciation to the following companies and individuals for material assistance rendered to its Alaskan expeditions:

Copper River & Northwestern Railway Co., Cordova, Alaska—transportation, subsistence, maps, storing launch for winter, etc.

Bausch & Lomb Optical Co., Rochester, N. Y.—loan of lens for camera and pair of field glasses.

Williams Bros. Co., Detroit, Mich.—pickles, mustard, catsup, pork and beans, preserves.

Borden's Condensed Milk Co., 108 Hudson St., New York city—Eagle Brand condensed milk; Pioneer Brand evaporated milk; Borden's milk chocolate.

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Walter Baker & Co.—milk chocolate.

Rainier Grand Hotel, Seattle, Wash.—discount on accommodations.

Schwabacher Hardware Co., Seattle, Wash.—discount on camp equipment.

H. O. Wilbur & Sons, Philadelphia, Pa.—chocolate and cocoa.

Schwabacher Grocery Co., Seattle, Wash.—discount on provisions.

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University of Wisconsin—loan of barometers, plane-table, alidade, etc.

We are also much in debt for courtesies to our party in Alaska and on the way by President S. W. Eccles and General Manager E. C. Hawkins, of the Copper River & Northwestern Railway Co.; Messrs. O'Neel, Van Cleve, Johnson, Withers, and Corser, of the Katalla Company, and Messrs. Murchison, Shields, and Whiting, of M. J. Heney's force; to Mr. John Dalton, of Cordova; to Messrs. Lathrop, Peterson, Crawford, and Camicia, of Valdez; to Rev. Mr. Rasmusson, and Messrs. Beasley, Stimson, Robinson, Flenner, and Gray, of Yakutat; to Captain MacGilvary and Mr. Inglis, of the steamship *Bertha*, and Messrs. Barber and Macgregor, of the steamship *Portland;* to the mine operators at La Touche; to Professors Landes and Meany, of the University of Washington; Messrs. Jamme, of Seattle, and R. P. Tarr, of Tacoma; Prof. U. S. Grant, of Northwestern University; Prof. R. S. Tarr, of Cornell University, and many others.

THE WONDERS OF THE MOSI-OA-TUNGA: THE FALLS OF THE ZAMBESI

By Louis Livingston Seaman, M.D.

In a far-away land, separated from the great basin of the Kongo by a low range of mountains, whose declivities point toward the Indian Ocean and which half a century ago was a veritable terra incognita, lies a scene of wonder and radiant beauty that is destined to become the Mecca of the globetrotter, the geologist, the artist, and the poet who seeks inspiration from communion with the romantic, the picturesque, and the beautiful in nature.

Only within a few years has this spot been accessible to the traveler without tiresome treks by bull-cart or saddle through a country of dust and desert; but modern engineering has brought its prodigality of splendors almost to the doorstep of the visitor, as three days of comparative comfort by rail from Cape Town, or an equal time from Beira, on the east coast, lands one amid its unsurpassed glories.

And well indeed will the visitor be rewarded for his undertaking, for in that curiosity shop of the continent he will find a concentration of beauties and charm unrivaled by any scene hitherto witnessed by human eye. Here is the Grand Canyon of the Zambesi, in its tropic setting; here is the native kraal, where the great Livingstone passed many years in the labor that made his name a household word; and it was here, too, that he first saw the "Mosi-oa-Tunga," and beheld Victoria Falls, a spectacle of wonderful sublimity, a Triton feared by the savages, a marvel to the geologists, a source of energy coveted by the vandalism of commerce, and an inspiration alike to painter and poet.

It is far and away the most romantic spot in the Dark Continent, and constitutes the greatest attraction of the Zambesi, from its source in the great divide of the mountains of the Kongo to where

FIRST BEND IN THE CANYON BELOW VICTORIA FALLS it finally fades into the Indian Ocean. The whole vast energy of nature—all the roused and slumbering elements—seem to have combined in its production, for nowhere has the Almighty revealed His might and glory in more varied form or with greater prodigality of charm.

It has been my good fortune to see the foaming waters of the Yellowstone, as they rushed over its precipice 210 feet to the Grand Canyon below and lost themselves amid the cathedral towers and picturesque spires of sandstone and chrome, whose brilliant tints and artistic grandeur are the admiration of the world. In our wonderful Yosemite I have gazed from the dizzy cliffs of El Capitan to where the Bridal Veil and Rainbow Falls dash into misty spray, half a mile below. At Niagara I have stood awe-struck and dumb in contemplation of the Almighty's masterpiece.

In the Himalayas, in Japan, in Switzerland and Lapland, in Alaska, in Uganda, at the Ripan Falls, and in South America I have seen waterfalls of wonderful beauty and charm, and while the Zambesi lacks many of the individual features which make these great natural attractions unique in their beauty, it nevertheless possesses, in its exquisite setting of emerald and tropic luxuriance, its grottos and rain forests, its dancing cascades and raging cataracts, its roseate sprays and frolicking rainbows, a diversity of charms surpassing them all.

So remote is this gem of nature from the beaten paths of the great world that no apology is made for inviting the reader to share in a further description of its beauty.

From immemorial times an atmosphere of mystery and superstition has hung over the Falls, so profound that Livingstone, who discovered them in 1855, had the greatest difficulty in persuading his followers to accompany him, as they believed the region to be the home of monsters and devils of destruction. Vestiges of these traditions still exist, although the Cape to Cairo Railroad, which crosses the river less than half a mile below the Falls is rapidly dispelling them.

Our approach was made by rail from the Indian Ocean at Beira, near the mouth of the Zambesi (that hotbed of micro-organisms, described by James Brice as the most deadly in Africa), and across the narrow belt of swamp and jungle forming the coast; thence up the gradual slope to the volcanic plateau that forms the real continent of Africa.

By morning an altitude of nearly 6,000 feet was reached, and a transition from the excessive heat and moisture of the lowlands was experienced that was most grateful and exhilarating.

This section still abounds with antelope, elephants, lions, and other large game, which find excellent cover in the tall elephant grass or the dense forests and jungles, while in the river hippos still gambol and flounder in ungainly herds amid the floating islands of rank vegetation of Nile reeds and papyrus.

With the altitude, however, came another and less grateful change. The forests were no longer in evidence, but in their stead were vast arid, birdless plains, with parched and hungry vegetation whose anæmic and stunted growth bears witness to the scarcity of moisture that so severely affects Rhodesia and the great stretches of veldt far away to the Transvaal.

Early in the morning of the third day we were suddenly awakened by the guard and treated to a scene of beauty never to be forgotten. Some 10 miles distant five enormous columns of vapor were shooting their roseate-tinted shafts hundreds of feet heavenward, while the faint roar of the Falls told us the Mosi-oa-Tunga—the smoke that sounds—was no longer a mystery.

Each moment increased the beauty and vividness of the scene. With the first rays of the rising sun came a picture of color of wondrous loveliness. Delicate tints of violet, crimson, and beryl played through the mounting spray as it shot higher and higher, ultimately disappearing as virgin clouds in heaven, while the ever-increasing thunders of the waters lent an added solemnity to the view.

Hardly could we wait to reach our destination, so great was our enthusiasm. But our hopes were doomed to momentary disappointment, only to be more than realized after a study of the environment; for, notwithstanding their magnitude, the first view of Victoria Falls is decidedly disappointing.

Although nearly a mile in width and 400 feet in height, the grandeur of their proportions is eclipsed by the sudden disappearance of the river, as it plunges into a narrow, rocky fissure extending across its entire width. Only at a single central point is there a breach in this fissure through which the Falls can be seen and appreciated in their full proportions, where the converging waters rush madly to the zigzag canyon below. So restricted is this view that there is an entire absence of that awe-inspiring and almost paralyzing effect which strikes the visitor dumb with wonder and amazement when Niagara bursts on his near vision. On first sight of the Victoria Falls one involuntarily exclaims, "Oh, how beautiful!" but they lack the majesty of our grand Niagara.

No single visit can adequately reveal the fulness of their charms, but repeated excursions must be made to their islands and precipices, their grottos and palm gardens, their rain forests and projecting crags, their rainbows and cataracts and many-sided views of their exquisite setting in the emerald framework of tropic forests, before their indescribable beauty can be appreciated. The fascination of discovering new and hidden charms from different points of view grows on the visitor and becomes one of the greatest attractions.

Had the Falls been in America, the Indians would surely have named them Minnehaha, Laughing Waters; for like a coy maiden are their fascinations, half concealing, half betraying their beauties, and requiring much wooing before revealing all their loveliness of hidden treasures and charm.

As the rainy season commences in Rhodesia in November and continues in the form of tropical showers until April, the most advantageous time to see the Falls is in May, when the seething torrents are at their flood. November also has its attractions, when the river is low, for then the chasm is comparatively free from mist, disclosing vistas and views of the great abyss of rare beauty, which before were wholly obscured by the whirling columns of spray.

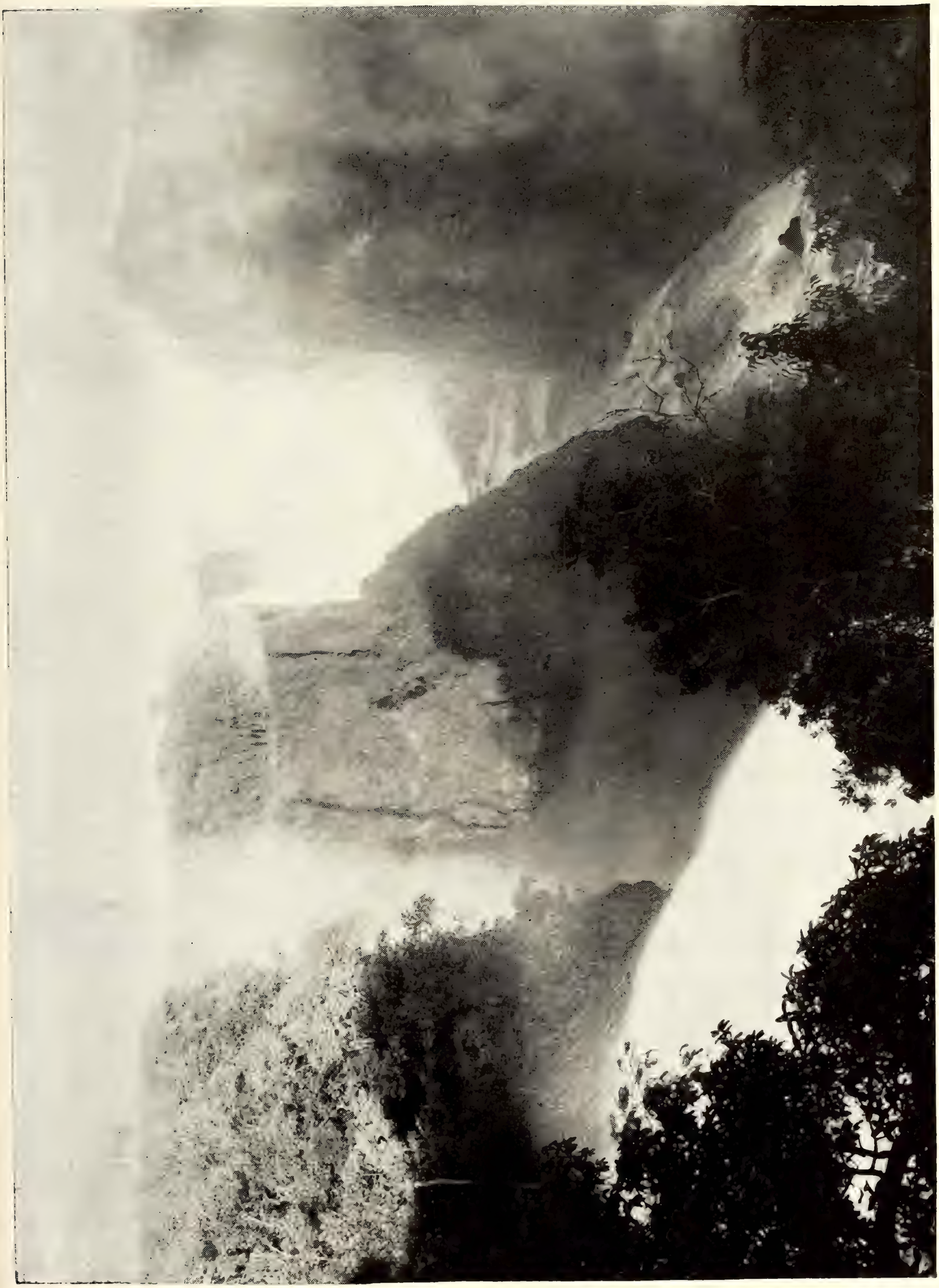
The bridge of the Cape Town and Cairo Railroad is the favorite point selected by artists, as the picture through the narrow gap at Danger Point exhibits the full extent of the angry waters, as they leap from the precipices to the abyss below.

The Chartered Company of Rhodesia, which controls the reservation miles above and below the Falls (as well as most everything else, movable and immovable, in South Africa), has erected a temporary hotel near the railway, where visitors are fairly well entertained, while from its verandas a magnificent panorama of the canyon and Batoka Gorge can be seen.

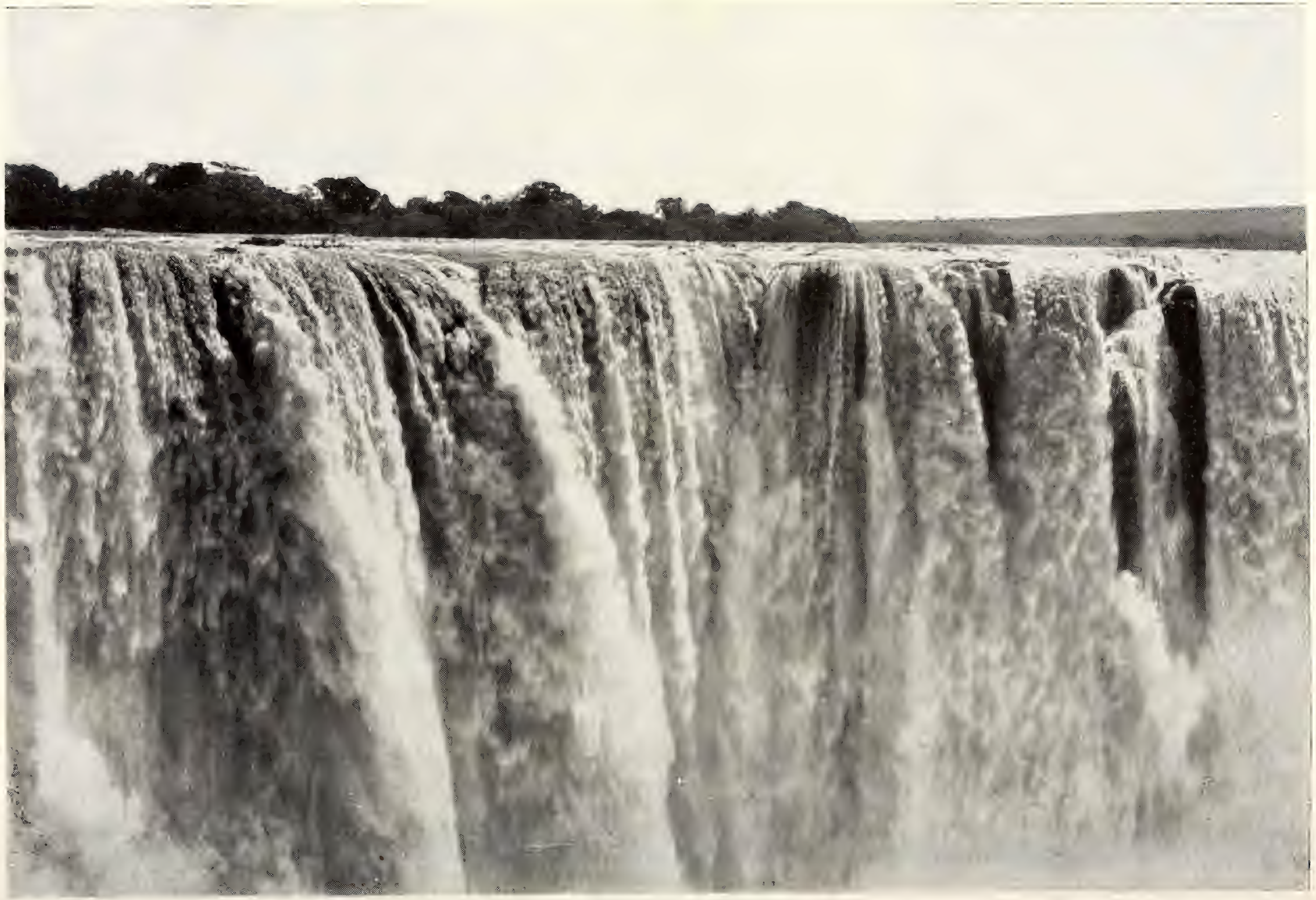
A walk of half a mile brings one to "the place where the rain is born," as the natives call the Rain Forest. This is a phenomenon of rare beauty and interest, especially to the botanist, for here the tropic heat and constantly falling spray produce a wealth of vegetation of wonderful luxuriance and variety. Every living thing bursts forth spontaneously here, from the delicate maiden-hair fern to the feathery-leafed palm and the hoary baobob, 70 feet in circumference, and under conditions so favorable that the great struggle for existence and the survival of the fittest is fought out with the intensest bitterness. Parasites and hungry climbing vines seize, like monster pythons, upon the great monarchs of the forest, sucking their life-blood or strangling them in their desperate effort for supremacy, only in turn to be reduced to mould or to fall the victims of new appearing and equally destructive enemies.

THE FALLS FROM CATARACT ISLAND

EASTERN END OF VICTORIA FALLS FROM THE "KNIFE'S EDGE," NORTH BANK



THE DEVIL'S CATARACT FROM WEST END (SEE PAGE 569)



A VIEW FROM "THE RAIN FOREST," ON THE OPPOSITE SIDE OF THE CLEFT INTO WHICH THE WATERS PLUNGE: THE FULL FLOOD LASTS TWO WEEKS (IN MAY) (SEE PAGE 569)

From the western extremity of the Rain Forest the leaping waters of the "Cascade" can be seen to best advantage, while its entire front, bordering on the great crevasse into which the river hurls itself, furnishes a superb view of the crest of the Falls from end to end, except when interrupted by the whirling masses of spray that shoot from the seething cauldron below. Here, too, innumerable brilliant rainbows, "those frolic children of the wanton sun," are seen in great perfection and varying positions, while white-winged swallows sportively shoot through their radiantly prismed arches, as they take their bath in the tinted spray (see page 568).

But the most thrilling scene is from the eastern extremity of the Rain Forest at Danger Point, where the treacherous vines and grasses, clinging to the rocks with hungry, desperate roots, tempt one to the very verge of the precipitate cliffs that seem to tremble with the terrific shock of the cataract. So dense here at times is the mass of vapor hurled from the seething cauldron that the sun's rays can no longer penetrate it, and complete darkness envelops one as he is delayed by the downpour, while the terrific thunder of the Falls drowns all other sounds and makes his own voice inaudible (see page 567).

Occasionally a violent blast opens a rift through the blackness and mist, disclosing a momentary view of the lashing waters in the boiling cauldron, whose heaving, battling surface and pyramids of emerald foam change with kaleidoscopic rapidity. It has been appropriately suggested by Mr. Knight that this spot be called Valkyrie, on account of its resemblance to the legend of the heroic daughter of Odin and its wild expression of the music of Wagner. Certainly no more fitting environment for the wild ride of the soul of the brave over the Rainbow Bridge to the Valhalla could be imagined.

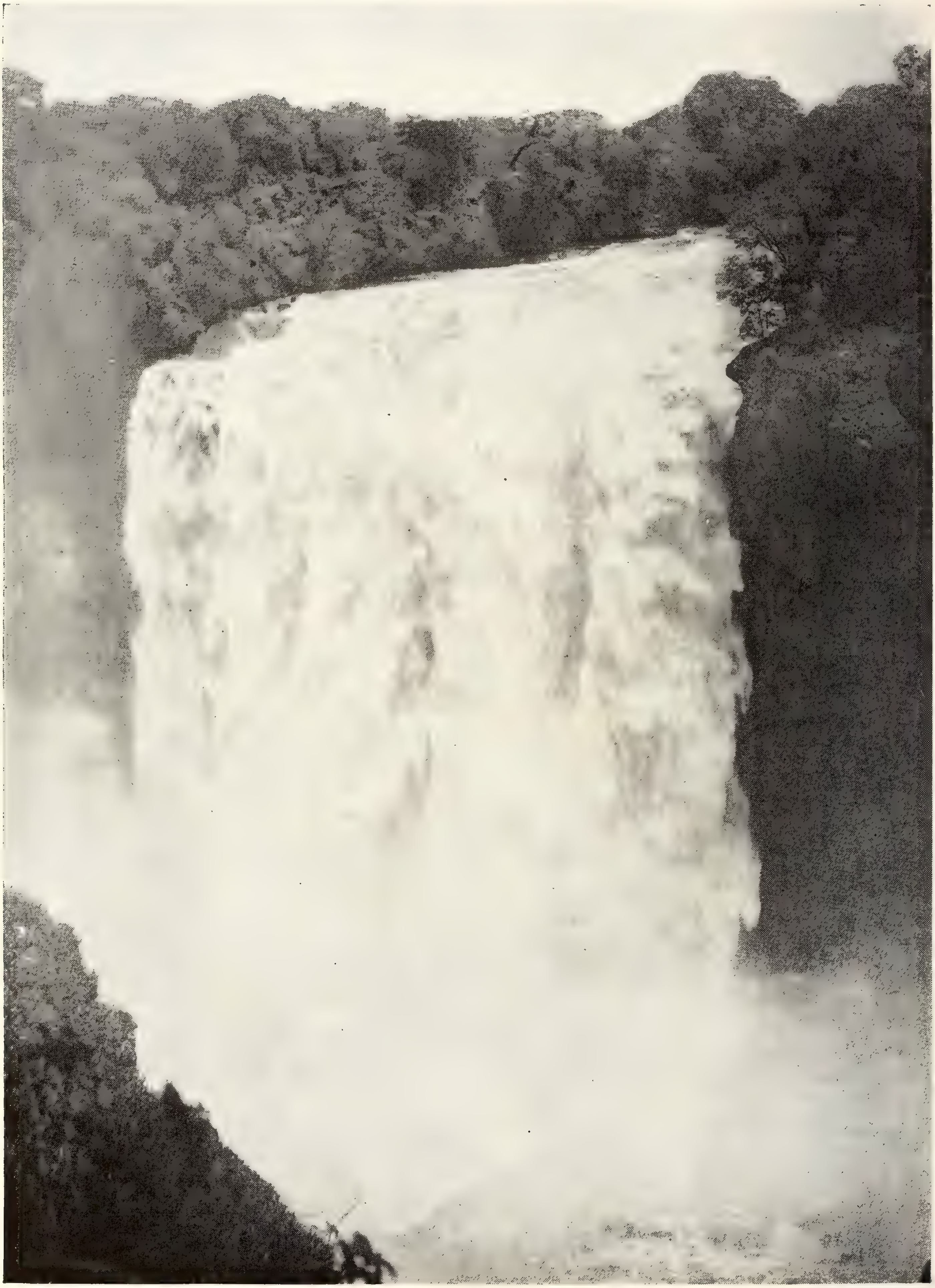
Even the Inferno of Dante, in the passage over the Styx, as pictured by Doré, does not surpass this as a spectacle of terrifying fury.

Another favorite study is the Kloof, or Palm Garden, hidden in the first of the serpentine curves of the canyon below the Falls and reached from the bridge by a zigzag pathway, which descends in comparatively easy stages through a tangled primeval jungle to the rushing waters of the gorge below. Here again Nature, with lavish hands, has shown her prodigality. Palms of enormous size and variety, bathed by eternal spray, mingle so densely with other forest growths as completely to shut out the direct rays of the sun and form a safe refuge for the richly plumed parrots and monkeys that frolic in their branches. From the edge of the waters of this tropic jungle an upward view of the Falls enables one to appreciate them in their full height and beauty, and to carry away a lasting impression of their majestic grandeur as seen from below.

The lip of the Falls is broken by four islands, which interrupt its flow just as Goat Island divides Niagara. The natives appropriately named the first of these Boruka Isle—"divider of waters." Between this point and the shore the river channel is deep and shelving, and the leaping waters of the cascade rush with fearful impetuosity, shooting clear from the precipitous walls, in their mad flight to the abyss 250 feet below, while the echoing woods ring with the thunder of their boisterous glee.

No less interesting is the second or Livingstone Island, both because of its historic interest and for the fascinating views of the chasm it affords. It was from this island the great explorer first peered into the awful fissure that seemed to engulf and swallow up the river forever. Singularly, too, the natives' name for it was Kempongo, meaning Goat Island; and, like its fellow at Niagara, it occupies an almost identical position on the extreme edge of the Falls, near their center.

In his own description Livingstone, who saw it in the late autumn, says: "In coming hither there was danger of being swept down by the streams which rushed along each side of the island; but the



THE DEVIL'S CATARACT

river was now low, where it is totally impossible to go when the water is high. But though we had reached the island and were within a few yards of the spot, a view from which would solve the whole problem, I believe that no one could perceive where the vast body of water went; it seemed to lose itself in the earth, the opposite lip of the fissure into which it disappeared being only 80 feet distant. At least, I did not comprehend it until, creeping with awe to the verge, I peered down into a large rent which had been made from bank to bank of the broad Zambesi and saw that a stream of a thousand yards broad leaped down a hundred feet and then became suddenly compressed into a space of 15 or 20 yards. The entire Falls is simply a crack made in a hard basaltic rock from the right to the left bank of the Zambesi, and then prolonged from the left bank through 30 or 40 miles of hills. The walls of this gigantic crack are perpendicular and composed of one homogeneous mass of rock. The edge of that side over which the water falls is worn off two or three feet, so as to give it somewhat of a serrated appearance. That over which the water does not fall is quite straight. Upon the whole it is nearly in the state in which it was left at the period of its formation."

Geologists of the present day, however, deny Livingstone's theory regarding the phenomenon of the formation of the Falls, claiming that it is due entirely to the processes of erosion, and that the river, by increasing friction through innumerable ages, has gradually frittered to granular atoms the dense rock and engraved the deep channels of the tortuous canyon. The basaltic rock which forms the greater portion of Rhodesia is of volcanic origin, proof of which is evidenced in the great lava-flows, which have been poured out in successive waves, covering the country in differing strata of varying porosity hundreds if not thousands of feet deep. Through this the percolating waters have deposited in the cavities the beautiful agates, chalcedony of various hues, quartz crystals, and zeolites that are found in abundance along the projecting surfaces of these amygdaloidal rocks, many specimens of which I found in the exposed gravel of the river bed.

It is said that these Batoka lavas, in consolidating, created a system of shrinkage cracks, with occasional long lines of "faultings," or fractures, which constituted planes of weakness that materially facilitated the erosive action of the river.

If this theory is correct, it is possible that the fissure into which the river plunges at the Falls is due to a fault-plane, where a vertical belt of comparatively soft material breaks the continuity of the harder basalt, and this belt or vein, connecting with others of the same or similar character, has been washed out or excavated by the undermining action of the river, thus explaining the complex phenomena of the Falls and zigzag canyons.

In the not distant future, when the Cape Town and Cairo Railway has reached the Kongo, and commodious passenger steamers ply directly to that great artery of Africa from American and English ports, a trip to the Valley of the Zambesi and its wonderful Falls will be among the popular pastimes of the day.

A FLASHLIGHT STORY OF AN ALBINO PORCUPINE AND OF A CUNNING BUT UNFORTUNATE COON

By George Shiras, 3rd

Author of "Photographing Wild Game with Flashlight and Camera," with 72 Illustrations, in The National Geographic Magazine, July, 1906, and "One Season's Game Bag with the Camera," with 70 Illustrations, in The National Geographic Magazine, June, 1908

WHEN one goes into the wilderness, whether in the destructive pursuit or in the quiet study of animal life, the greater the experience the more certain is the conclusion that only on rare occasions is it possible to become acquainted with the habits, the appearance, or the special characteristics of any individual member of a species.

In some 40 years' familiarity with the white-tail deer, a portion, at least, of each season spent in the same locality, and more often than not, watching them feed, night after night, in front of the jack-light, I have never in all such time felt certain of having recognized any of these animals on a succeeding season.

A magnificent stag, which could be repeatedly identified during one season by the shape of the antlers, was shorn in the winter time of these emblems of his sex, and the new horn-growth of the following season was, presumably, quite dissimilar in size and shape.

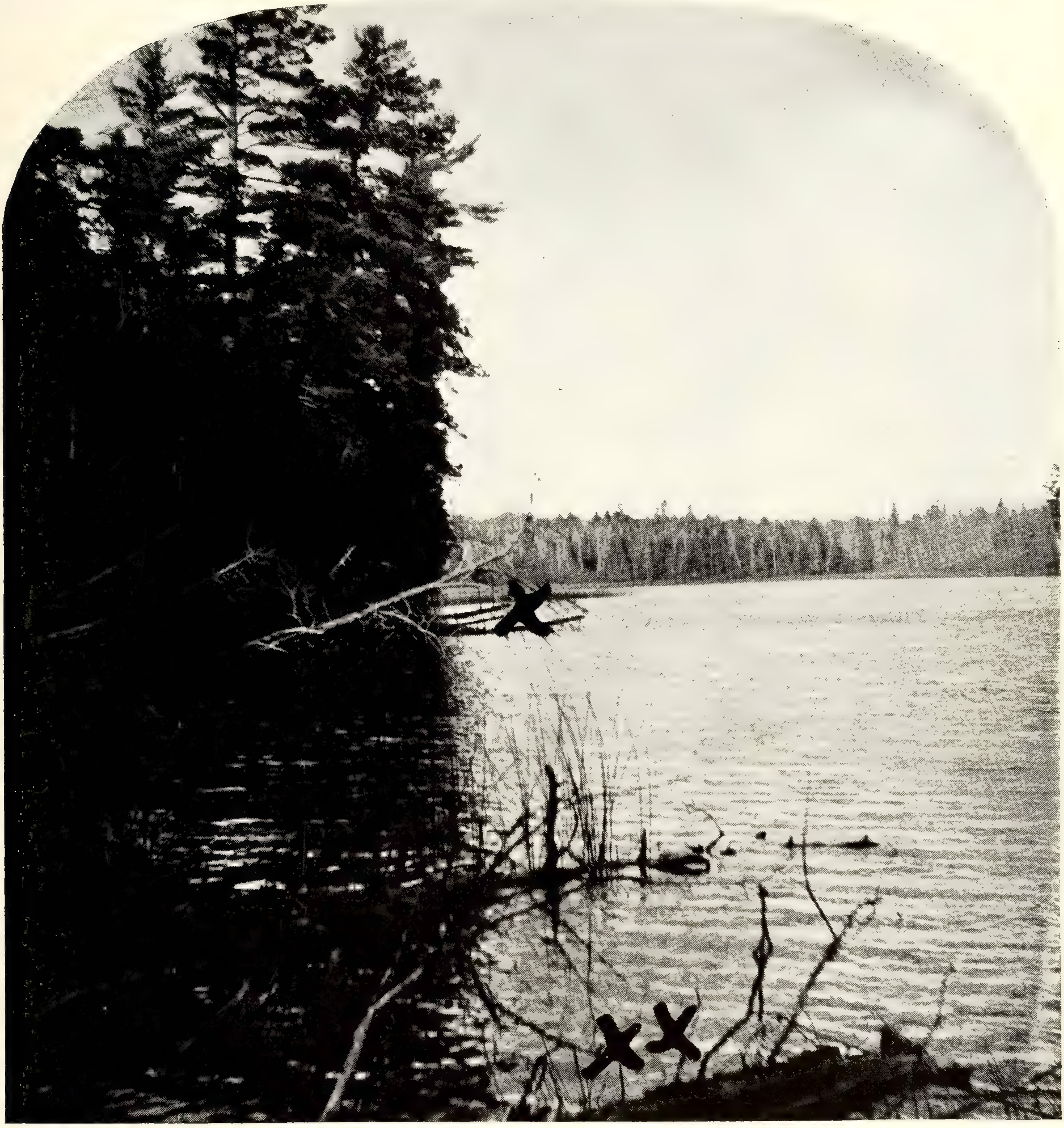
A doe accompanied by peculiarly marked, spotted fauns could be easily recognized in the same general locality, when feeding on aquatic plants or when splashing in the water to escape the insect pests; yet, if in the fall or winter this little family escaped the hunters or the timber wolves, who would know the mother the next summer with her new and differently marked young, or the separated yearlings, in their unspotted coats? With the moose, elk, caribou, and bear it was the same, and the exceptions, in the writer's case, relate largely to the smaller varieties of quadrupeds.

The examples taken in the present article are the porcupine and the raccoon, which, by reason of one species occupying nearly all the country from our northern States to the tree-limit in the Arctic circle, and the other from lower Canada to the Gulf of Mexico, are ones that we are either personally familiar with or ought to be willing to acquire information about.

The porcupine is a rodent of the North—the denizen of the dark-green coniferous forest—where half the year the snow lies deep and the animal slumbers in a winter torpor far within the cavernous rocks or hollow logs, protected from the biting cold by drifting snows that conceal all evidence of the animal's retreat.

During the winter thaws, and more often in the early spring, the deep, wide furrows of this clumsy animal may be seen criss-crossing the surface of the receding snow as he seeks to break his long fast on the tender bark of the pine sapling, the swelling buds of the sugar maple, or by climbing to the uttermost limb of a spreading elm, where he is able to seize in his stubby paws the half-open leaves of his favorite tree.

Generally this animal, though of the coldest climes, is quite susceptible to sudden changes of temperature, and even in midsummer, if the wind is northerly, or the air damp and penetrating with the drizzling rains of such a latitude, one

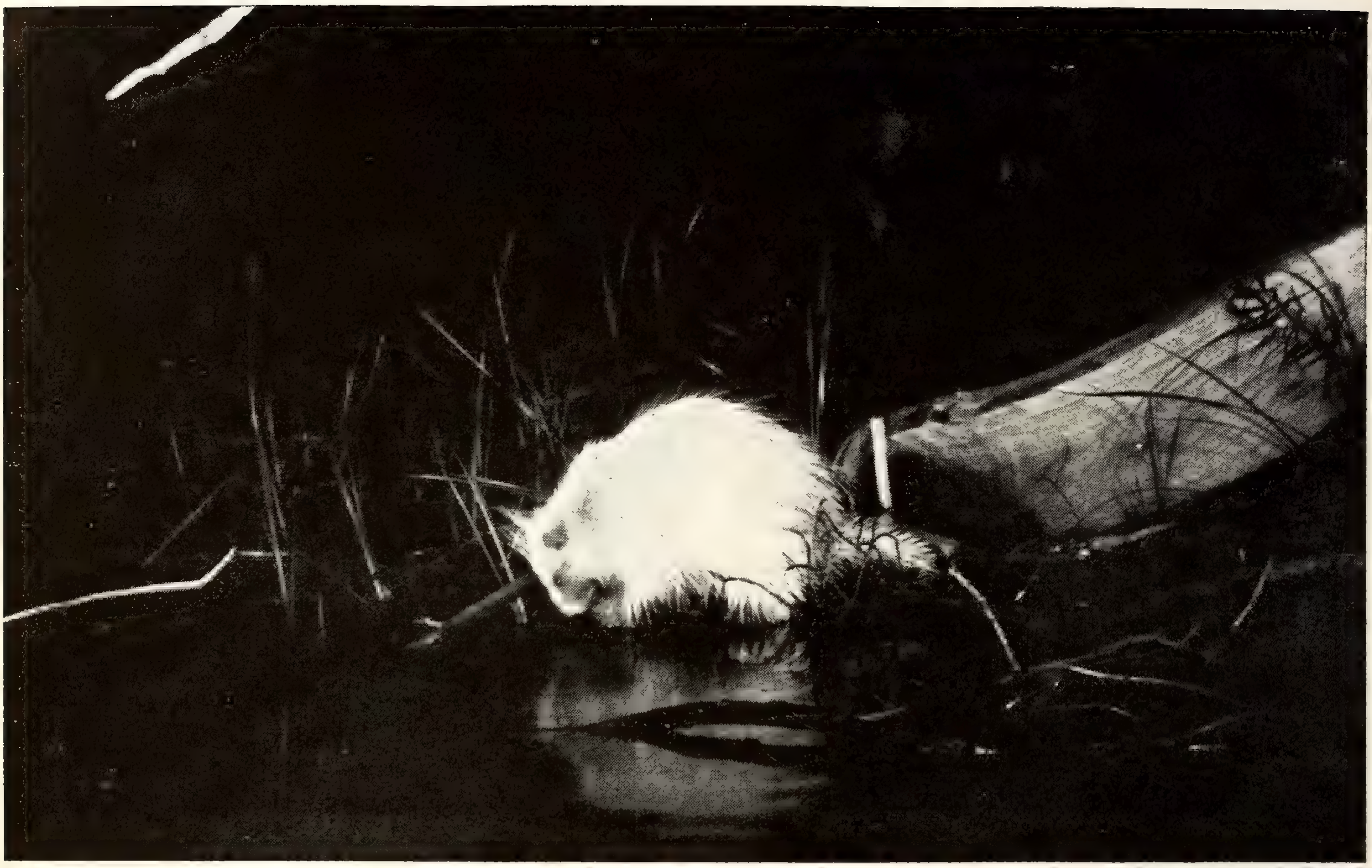


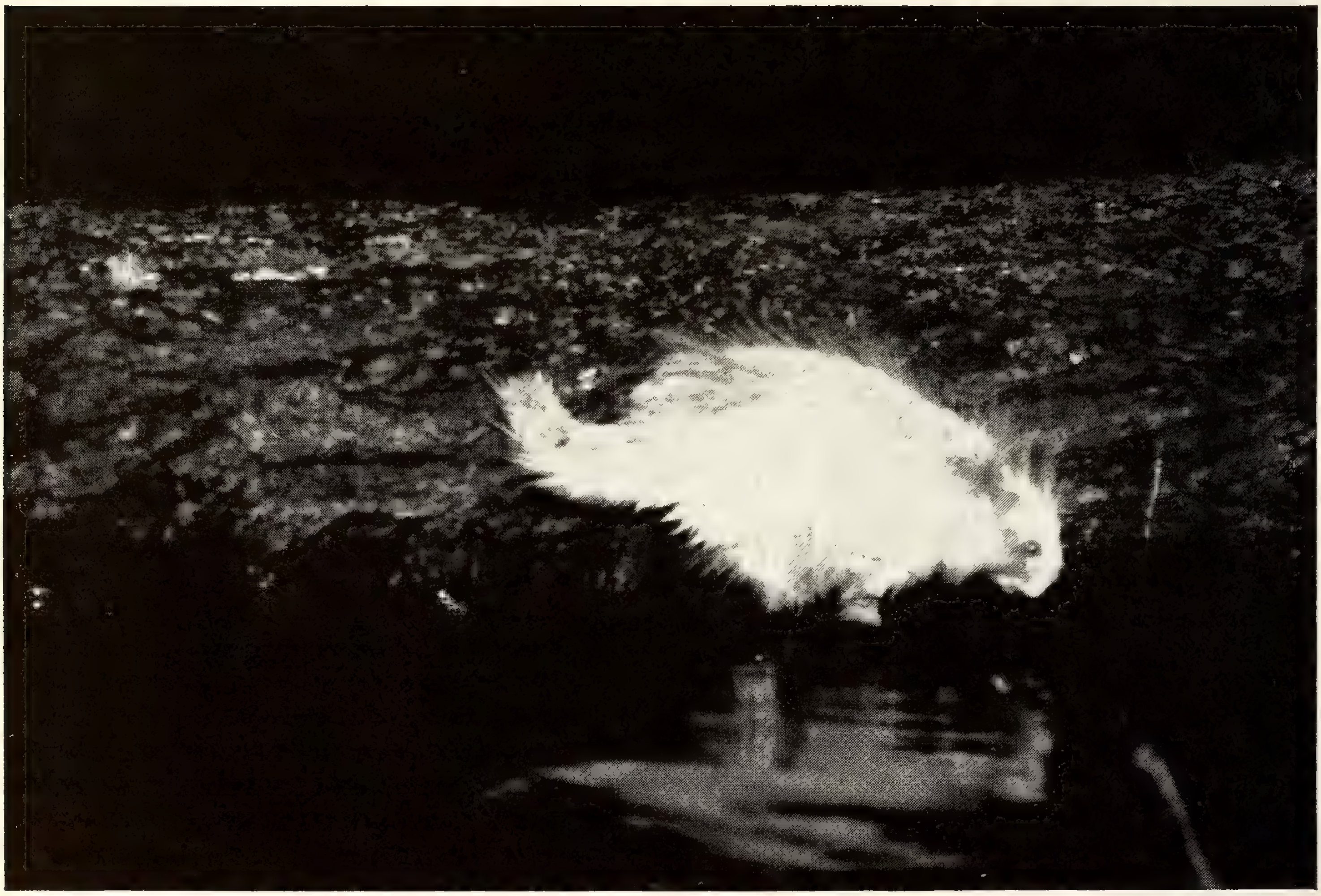
NORTHEAST SHORE OF WHITEFISH LAKE, WHERE ALL THE PICTURES IN THIS ARTICLE WERE SECURED BY THE AUTHOR

The porcupine always came to the water at X and returned to its cave on a deer trail back of X X. All the coon pictures were taken on the shore back of X X. Photo by George Shiras, 3rd.

may look in vain for it, just as the shores of little lakes and ponds may fairly bristle with these waddling creatures whenever the soft winds blow and the setting sun leaves the darkening shores still radiating in the afterglow of a summer day.

In the days of the rifle, long ago, and when the game season opened much earlier than now, the appearance of porcupines along the watercourses, as evening approached, was the almost certain harbinger of venison before the twilight dimmed the sights, for deer move about much more freely under the conditions last described.





Photos by George Shiras, 3rd

FIRST FLASH OF THE ALBINO PORCUPINE WHEN EATING FRAGMENTS OF MOSS: JULY 1, 1901, 8 P. M. (SEE PAGE 586)

SECOND FLASH, ON SAME EVENING: THE ANIMAL IS VAINLY ENDEAVORING TO FIND FOOD IN FIVE FEET OF WATER

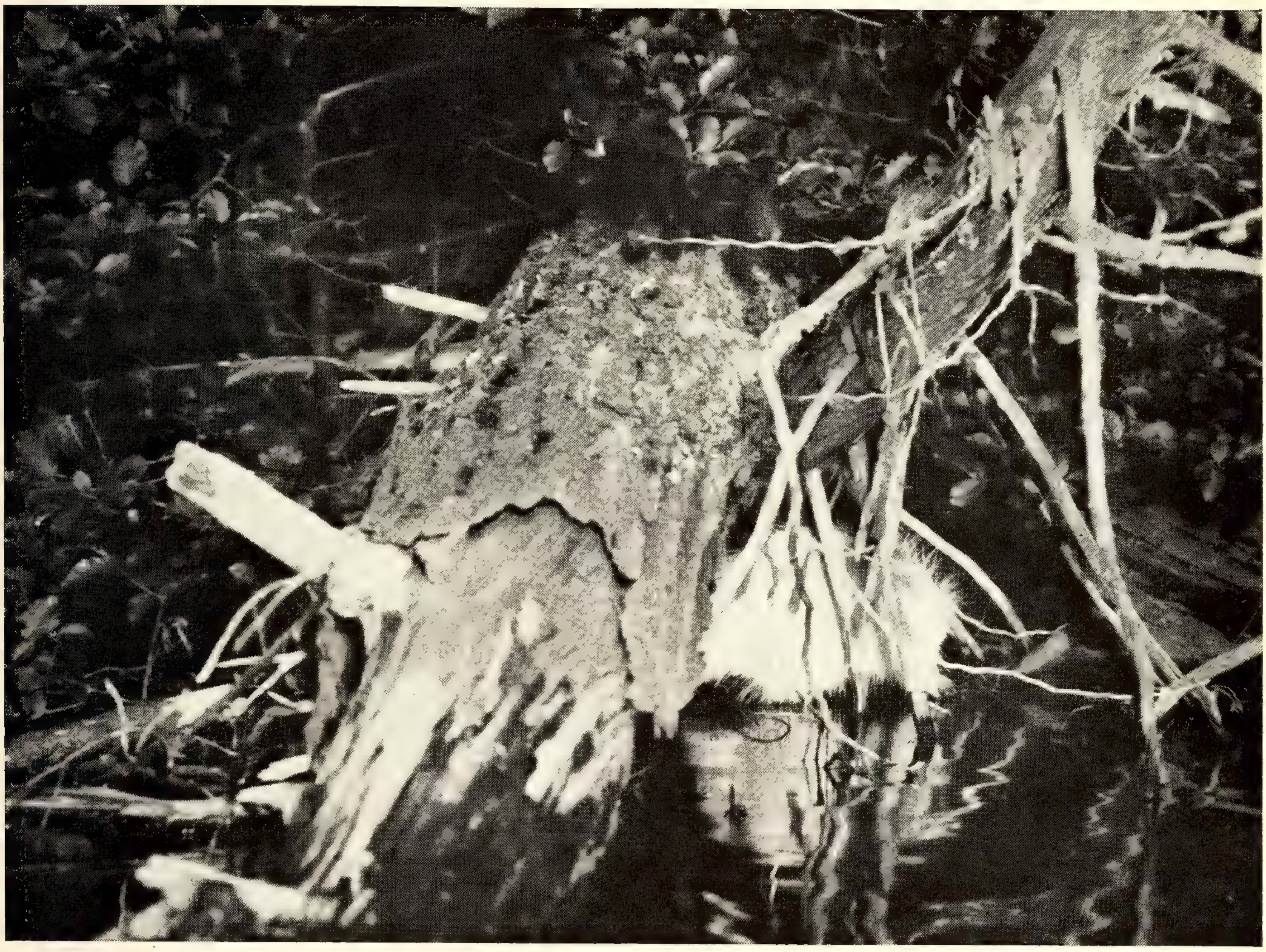


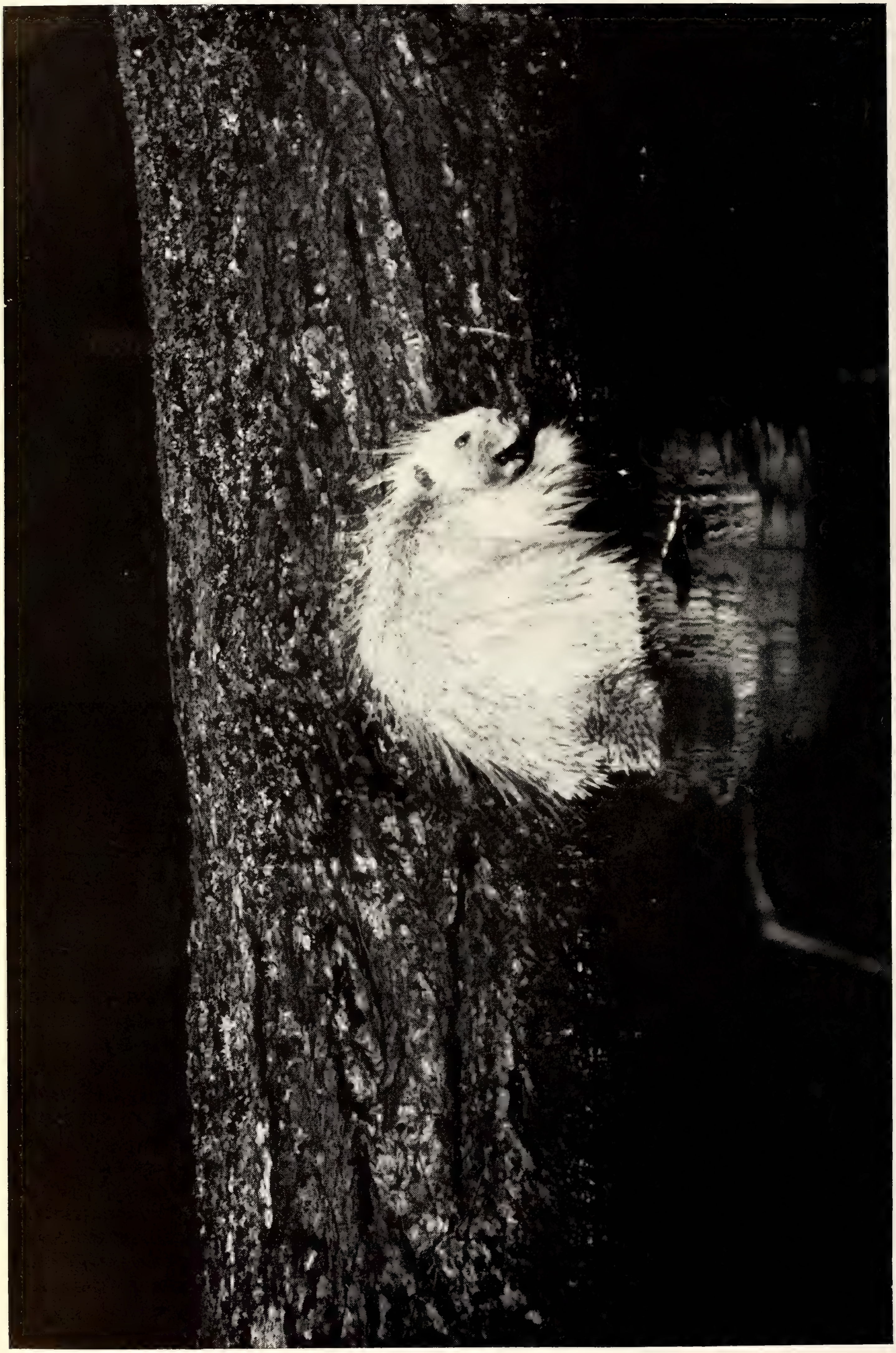
Photo by George Shiras, 3rd

THE ONLY FLASH OBTAINED THE SECOND SEASON: FEEDING IN A DARK AND PROTECTED CORNER, JULY 20, 1902, 8.15 P. M.

THE THINGS A COON WON'T EAT ARE THE ONLY THINGS A PORCUPINE WILL EAT

The coon, on the other hand, is an inhabitant largely of the deciduous forests, in the temperate and semi-tropical zones, especially where such tracts contain abandoned clearings, swamps, ponds, watercourses, and open glades, with the infinite variety of wild fruits and berries, the eggs and young of nesting birds, and frogs, mussels, and the crayfish of submerged lands; and, while he is forced to hibernate in his more northerly range, he greatly prefers a climate where he can indulge in nightly rambles and in gratifying a most omnivorous and endless appetite. Like his nearest prototype, the black bear, he can go for a long period on a single and limited form of diet, but is always willing, when the opportunity comes, to partake of about every variety of natural and artificially prepared food which Nature or man may grant him. In fact, the only things he won't eat are the only things a porcupine will eat, namely, bark, leaves, and water plants.

Comparing and contrasting the porcupine and the coon, one finds so many dissimilarities that little can be rated in common. It is true that there is somewhat of a resemblance in size and shape, and in the general blending of the black, the white, the gray, and the yellow, so that when one sees a fat coon or a chubby porcupine curled up asleep in the higher crotch of a shaded treetop; or, again, in the distance observes one of these animals walking a log or ambling beneath the alders in search of aquatic



THIRD SUMMER: THE PORCUPINE IS SAVED FROM FALLING INTO WATER BY SEIZING STUB IN TEETH

This season it was known that the animal was blind. July 6, 1903, 8.10 p. m. (see pages 590-591). Photo by George Shiras, 3rd

Photo by George Shiras, 3rd

PICTURED WHEN TRYING TO PASS UNDER BRUSH WHERE THE WATER WAS TOO DEEP: JUNE 28, 1903, 7.20 P. M.

food, he may be momentarily in doubt; but otherwise it is hard to imagine two animals that in habits or physical characteristics are less alike.

A porcupine is slow, clumsy, dull witted, solitary, and of limited range; the coon is quick, cunning, often gregarious, and a most energetic traveler. One occupies crevices in the rocks or hollow logs and in seclusion whenever possible, while the other prefers comfortable quarters high up in the cavity of a living tree, or in some portly stub that will shelter all the members of his family or such bachelor companions as he may wish to consort with.

THE PORCUPINE'S LOVE OF SALT IS IRRESISTIBLE

While the porcupine usually bears but one young, it has so few predaceous enemies willing to risk impalement upon the thousand bristling quills, that this animal would ordinarily increase more rapidly than the coon, with its numerous progeny, were it not for the fatal habit of visiting every human habitation near its range in search of salt or anything possessing a saline flavor.

Each homestead, trapper's cabin, or lumber camp will in the spring attract every porcupine for miles about; and, if these habitations be temporarily unoccupied, the destruction is often most extensive, for after devouring empty pork barrels and everything about the kitchen door that has been saturated with brine or grease from the sink, they are then content to gnaw anything containing the slightest salty flavor, and this includes ax-handles, garden implements, gunstocks, pack-straps, harness, wooden latches, door-jambs, or anything else that the sweat from the hand leaves a trace of salt upon.

Many years ago, when it was customary to leave my hunting skiffs turned bottom up beneath some heavy hemlock,

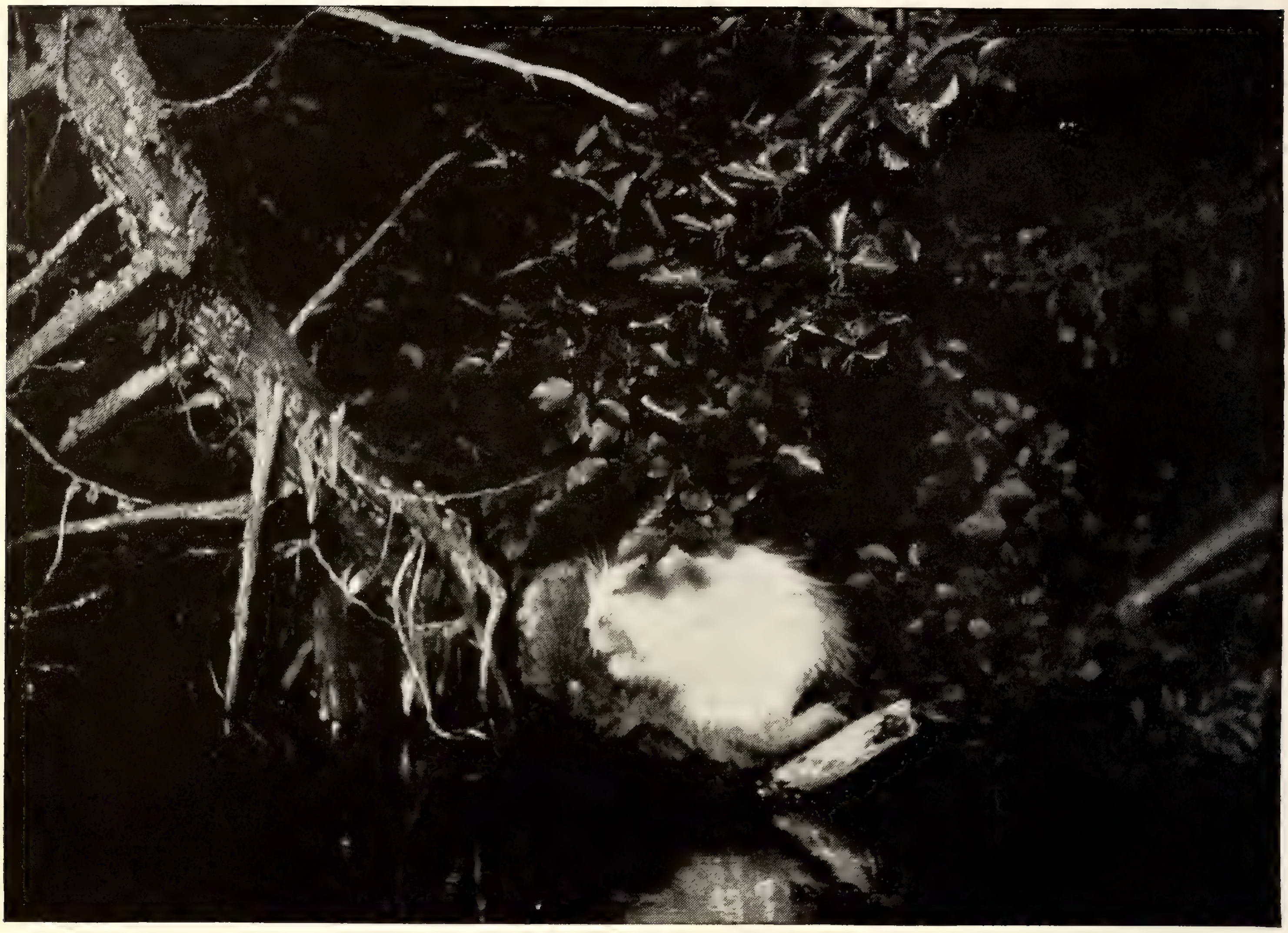


Photo by George Shiras, 3rd

FOURTH SUMMER: THIS FLASH SHOWS THE ALBINO MOTHER WITH HER BLACK YOUNG ONE FEEDING BY HER SIDE: JULY 24, 1904, 9 P. M. (SEE PAGE 591)

I remember going once in the early summer for the purpose of examining their condition, and, on approaching the spot, was greeted with a sound of grinding and crunching not unlike a distant sawmill. Within the interior of a decked-over ducking-skiff, brought the previous year from the East, I found three large porcupines putting the finishing touches upon all the ribs and other projections that could be scored by their flat, yellow teeth. The boat was nearly a wreck, and for a time I was puzzled, because such a thing had never happened before.

My guide, standing by, suggested the solution by asking whether I had not used this boat the previous season on Long Island Sound, and although he had never seen salt water, he knew just as well as these animals what this meant.

Every year thousands of porcupines are killed by indignant hunters and lumbermen, and not a few by tenderfeet and young boys, whose first sight of this apparently ferocious beast leads them to believe it a work of heroism to shoot or club to death the most stolid and least aggressive animal of the American forest.

At a time when the Indians were numerous along the Great Lakes these animals were not only used for food, but the longer quills afforded the principal means, when variously colored, of ornamenting their moccasins, hunting-shirts, birch-bark baskets, and the like, but in recent years very few practical uses are made of this animal, except in Alaska, where the natives and transient explorers still seem to regard it as a toothsome article.

Sometimes one hears a lumberman complain of the extensive destruction of growing timber by porcupines. My ob-

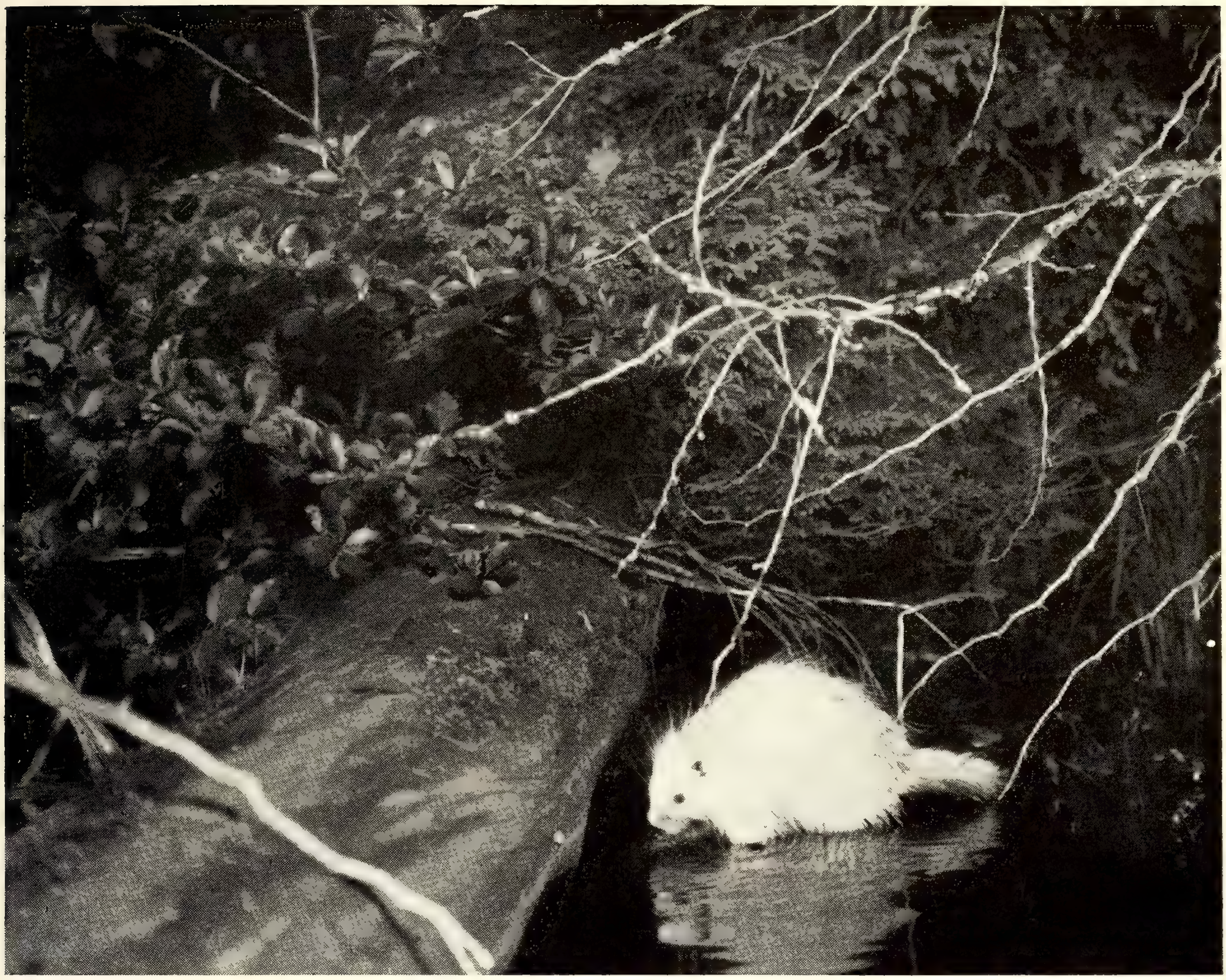
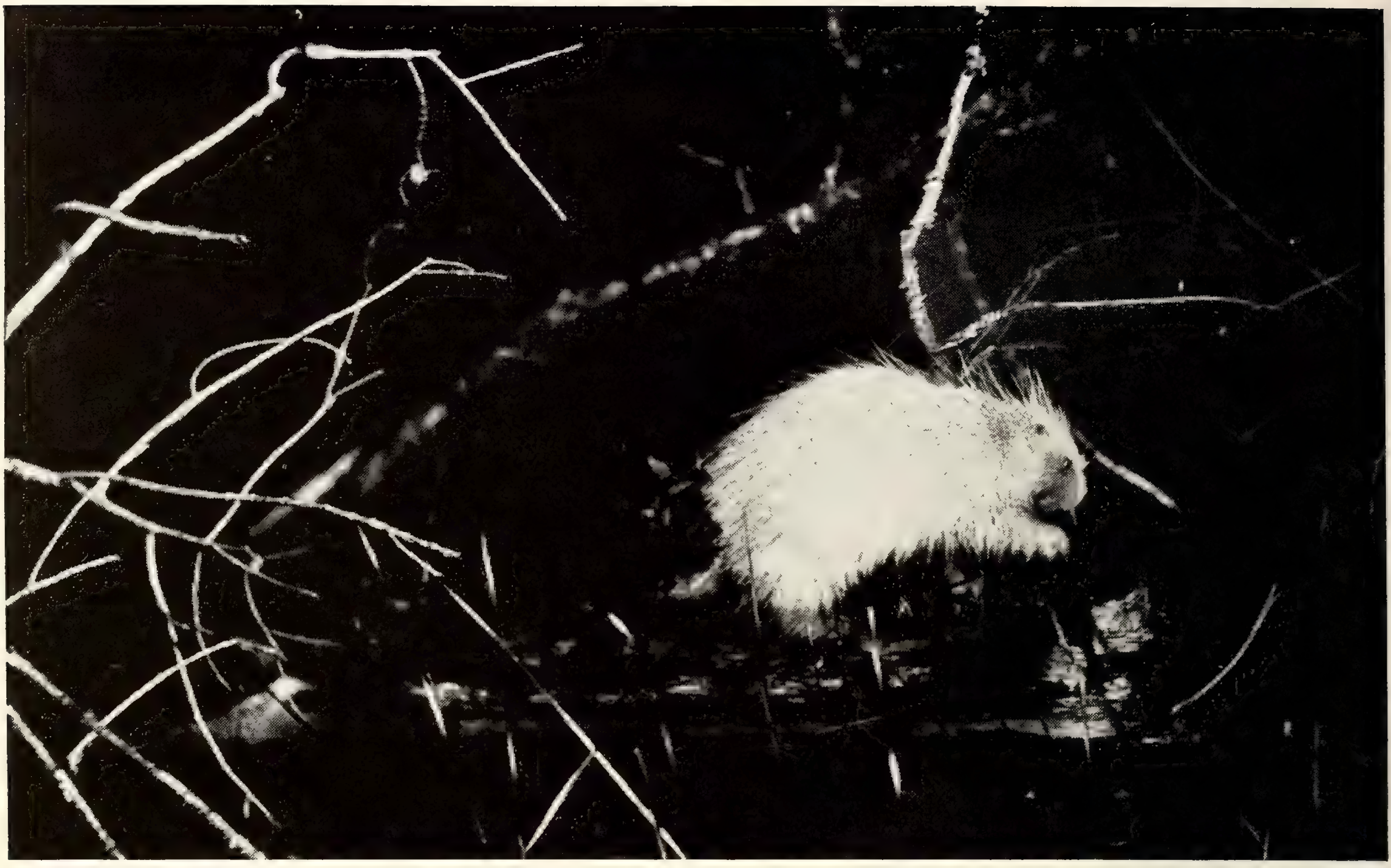


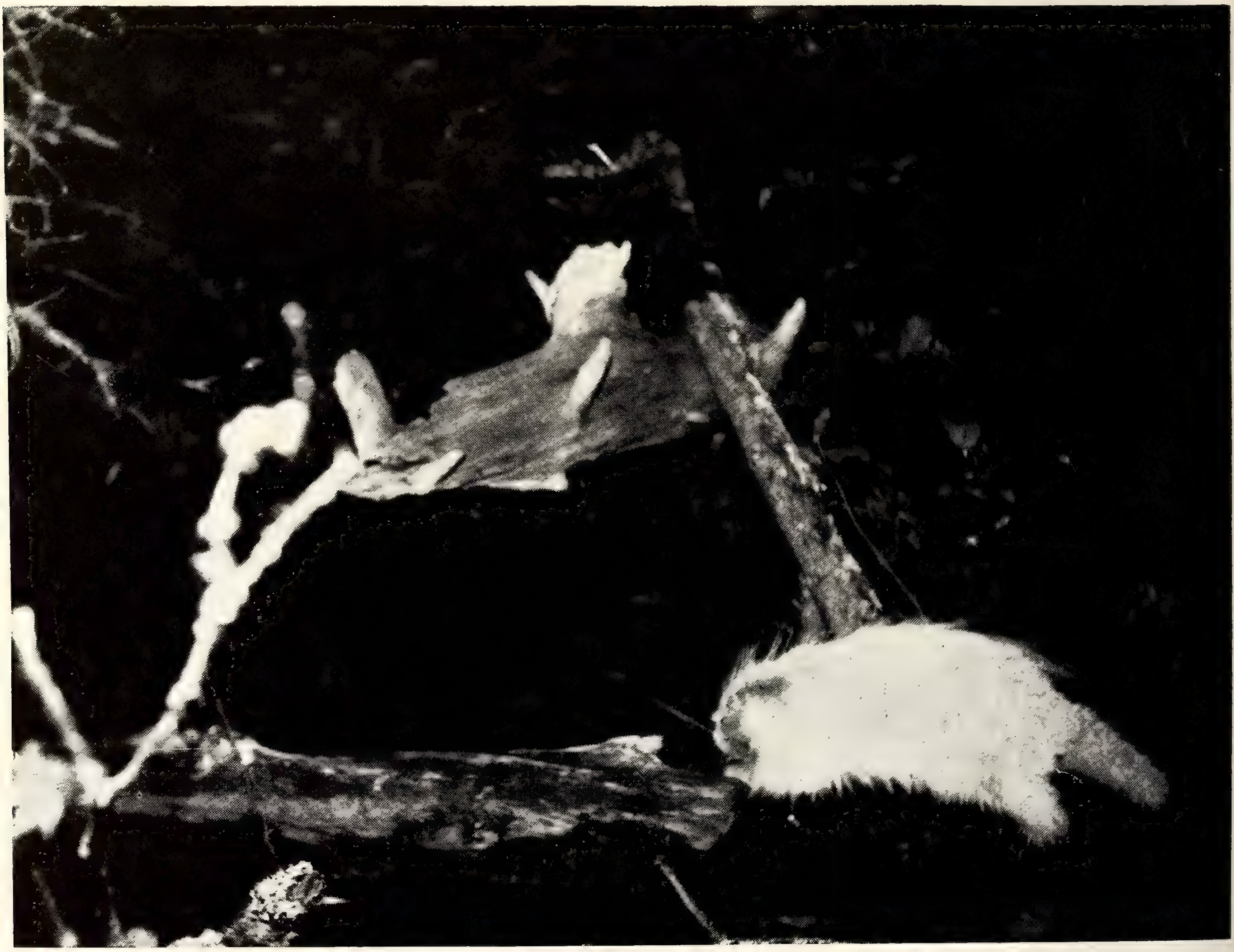
Photo by George Shiras, 3rd

PERHAPS THE BEST FLASH TAKEN DURING THE SIX YEARS: JULY 25, 1904, 8.20 P. M.

servation on that point suggests that it depends largely upon the abundance and variety of the food. Along the south shore of Lake Superior, during a period of nearly forty years I never saw any particular evidence of such destruction. Though many elms were pruned year after year of their terminal limbs, so that such trees grew long and straight like a poplar, and sometimes sugar maples were partly girdled at the base, yet apparently by some provision of instinct there was usually enough bark left to prevent the tree from dying. Again, I have seen a few young pines more or less injured and occasionally destroyed by this animal. But so scattered and inconsequent were these injuries that they attracted little attention.

However, in this region the forest is composed of a great variety of mixed timber, besides second growth and shrubbery. On the northwest end of Lake Superior, in Minnesota particularly, I saw much evidence of injury to the young pines. From the canoe I could often notice the white trunks and limbs of trees that had been recently denuded of their bark, and sometimes as many as fifteen or twenty in a group were destroyed. On the higher ranges of the Rocky Mountains I also saw many trees that had been killed by porcupines; but in both these localities the trees were practically all coniferous and there was a marked absence of the hard and soft wood timber found along the south shore of Lake Superior.





FIFTH SUMMER: WALKING ALONG A LOG IN A MASS OF DEAD LIMBS: JULY 1, 1905, 9 P. M.

AWKWARD POSITION, DUE TO BLINDNESS, WHEN TRYING TO CLIMB ON LOG: JULY 12, 1905, 8 P. M.

Probably the porcupine is the only animal which could exist unharmed so many years when both blind and deaf. Photos by George Shiras, 3rd

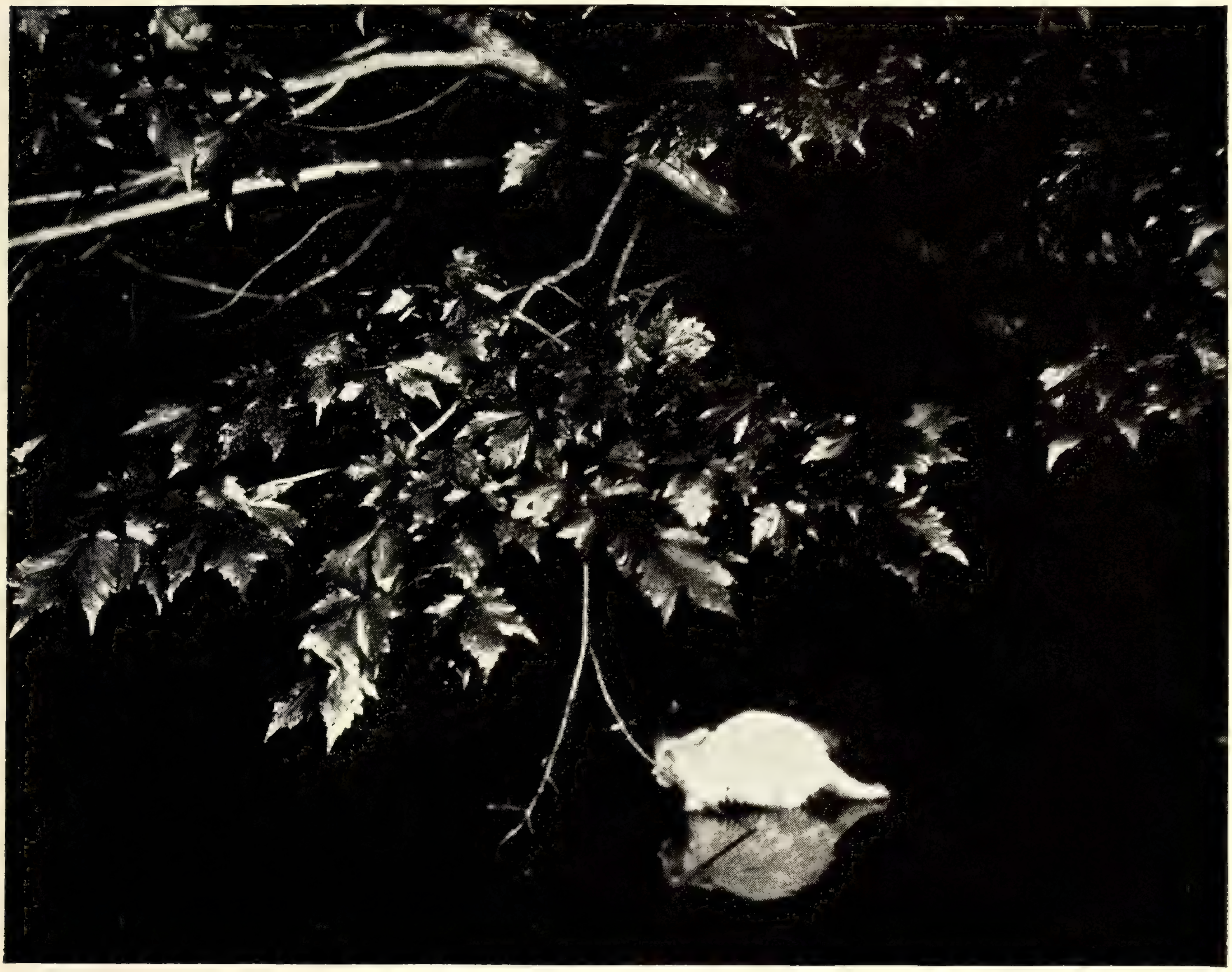


Photo by George Shiras, 3rd

SIXTH SUMMER: A DIFFICULT PICTURE TO SECURE, IT BEING NECESSARY TO LOWER CAMERA AND FLASH MACHINE TO SURFACE OF WATER TO CATCH THE ANIMAL, WHICH WAS ALMOST HIDDEN UNDER A MAPLE BOUGH: AUGUST 13, 1906, 10 P. M.

The wide distribution of the coon and his abundance in the more settled portions of the country, together with his voracious appetite, often makes him a nuisance to the farmer. Ground-breeding birds, as well as those in the highest trees, are greatly reduced in localities where the coon is at all numerous. In the Southern rivers, lakes, and along the Gulf of Mexico, all the large colonies of breeding birds are located on islands and sandbars; otherwise they would be unable to rear any of the young. Just what a single coon can do in a poultry yard is referred to later (see page 592).

In the following biographies of a white porcupine and a coon it may be noted that all the pictures were taken by flashlight, and that each series represents two quite distinct methods of night photography. The porcupine was taken from the bow of the canoe, the flash being fired by hand, and at the instant when the animal was in focus and in the best attainable position—a method that I have generally followed in photographing moose and deer; while all the pictures of the coon were taken automatically by the animal pulling on a piece of bait attached to a string connected with the flashlight apparatus, the variety in surroundings and in position being regulated by preparations made in advance.

Though fully 30 pictures were made of

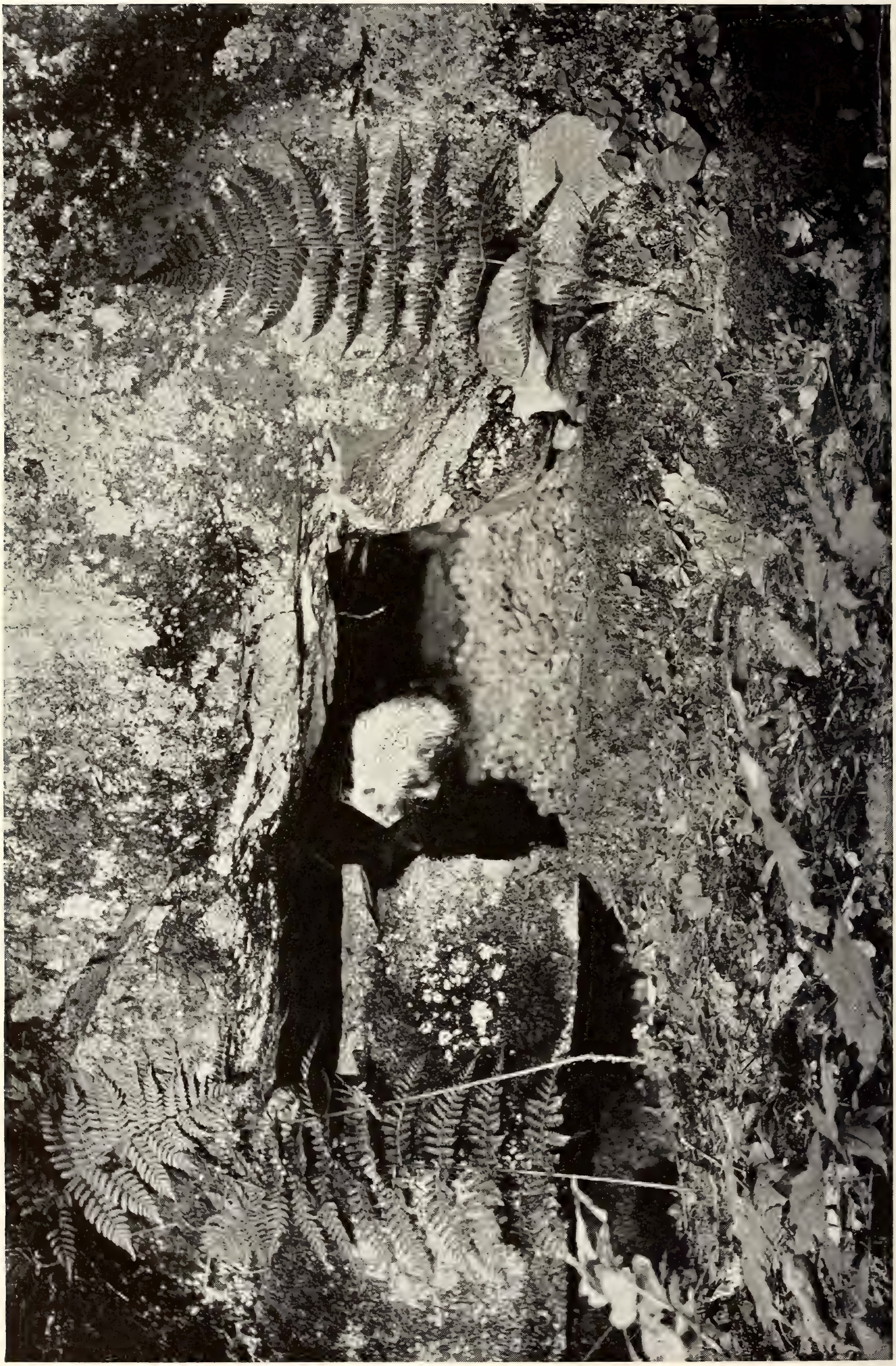


Photo by George Shiras, 3rd

THE DEN OF THE WHITE PORCUPINE, IN SUMMER: DOUBLE PRINTING

Photo by George Shiras, 3rd

THE TOMB OF THE WHITE PORCUPINE, IN WINTER

this one coon—with several cameras set at different angles—I never saw the animal during the entire bombardment.

This latter method is by far the most effective in taking night pictures of many predaceous animals—as they are not only hard to locate from a canoe, but usually show great distrust of the approaching jack-light, which, however, is only regarded with slight curiosity by the different members of the deer family.

THE ALBINO PORCUPINE OF WHITEFISH LAKE

When the writer was a lad intent upon killing his first deer, one early autumn he followed in the wake of an old Ojibway trapper, and on the second day reached the shores of a beautiful little lake twenty miles east of Marquette, Michigan, and located, as was determined in after years, some eight miles south of Lake Superior. This lake was situated in what was then not only one of the wildest and least known portions of the Upper Peninsula, but the very center of the summer range of the white-tail deer. Of each successive trip thereafter and the many victims of the gun there is no need of giving an account here—for the score with the flashlight and the sensitive plate has long ago surpassed the record of former destruction. And it was here in 1888 that night pictures of wild animals had their inception, and many innocent lives have been saved by reason thereof.

On the afternoon of July 1, 1901, I had been photographing deer in a long, narrow slough at the end of the lake, which received the waters of the upper river and lay mortised in between sloping

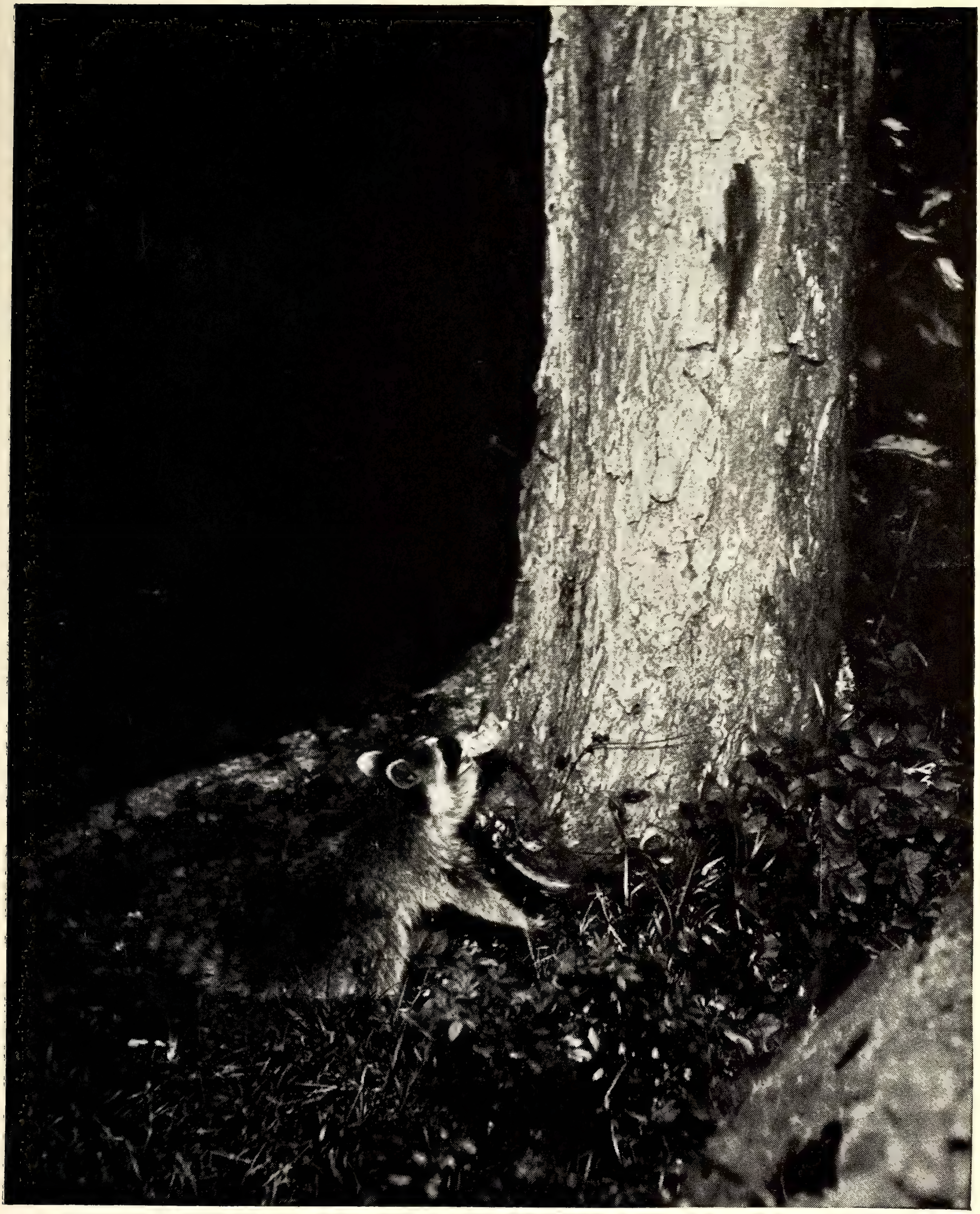
THE COON TAKING HIS OWN PICTURE BY PULLING STRING BAITED WITH CHEESE AND FISH (SEE PAGE 594)

Picture shows he preferred the cheese to the fish. Note how he holds the cheese in his paws, eating like a monkey. Photo by George Shiras, 3rd

hills nearly four hundred feet in elevation. As the sun lowered behind the tops of the great pine forest the canoe was pushed out from the blind of freshly cut balsam, and under the impetus of two paddles we entered the lake on a rapid run for camp, situated half a mile below the lake, on the banks of the lower river.

On approaching the outlet I noticed a small, snow-white object, which, in the darker shades of the western bank, was doubtless much more conspicuous than would have been the case in sunlight. What was it? At this season of the year the rabbits, weasels, and the owls were no longer white, and as the object showed motion and there was no breeze to stir a fugitive paper that might have been carried from my house-boat in an adjoining bay, it was certain that we were gazing upon an animal never seen heretofore during the many years this little lake had been traversed by a canoe.

When within 100 yards, my guide said it looked like a young polar bear but walked like a porcupine—a view that I concurred in. Just then it walked into some thick brush, and we cautiously approached, to be gratified in a few minutes by the appearance of a most perfect specimen of an albino porcupine. It seemed wholly unconcerned about our presence and intent upon pulling out of the water fragments of tender moss, which were eaten with great relish. Every portion of the body was white—quills, hair, claws, and nose—while it was certain it did not have the beady black eyes of the normal animal; but whether they were pink could not be determined at the time.



THE NEXT NIGHT ONLY CHEESE WAS USED FOR BAIT, A PIECE OF WHICH CAN BE SEEN BETWEEN HIS OPEN JAWS

The flash was fired for all these coon pictures by the coon itself. Photo by George Shiras, 3rd

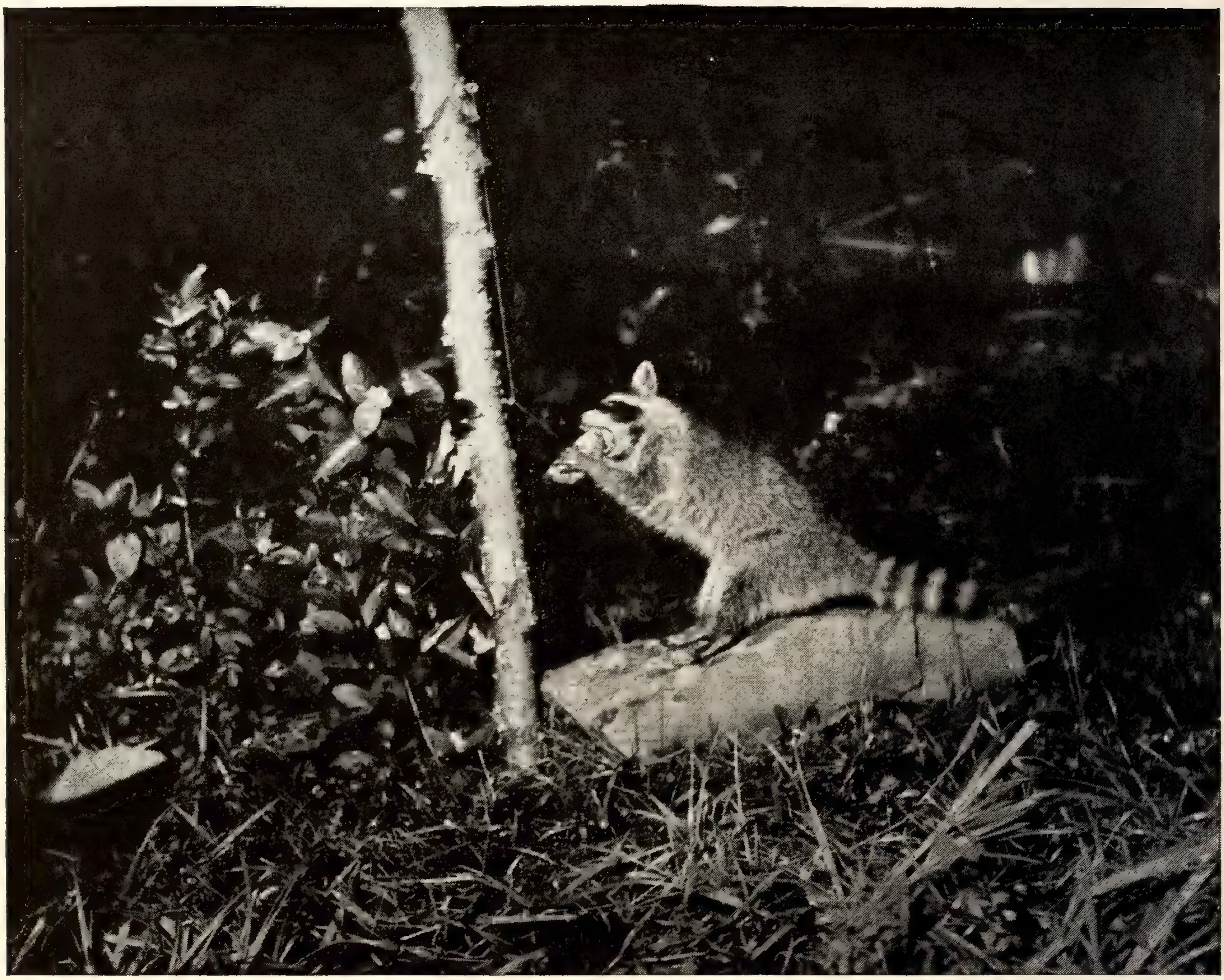


Photo by George Shiras, 3rd

THIS FLASHLIGHT SHOWS THE CHEESE AT THE END OF THE STRING, AND WAS TAKEN WITHIN A FEW FEET OF THE WATER

After a careful inspection of the animal the trip was continued to camp, as it was then too dark for an instantaneous daylight picture and too light for a flashlight. Finishing a hurried meal, we returned for a flashlight picture, and as the moon was full that night there was no need of using a lantern. Reaching the locality, we found that the moon was up, and directly opposite, so that its rays penetrated beneath the overhanging bushes. But not a sight or a sound of the animal.

Slowly the canoe passed along, and at a point about 75 yards south of where we had last seen it the soft, crooning notes of a porcupine were heard back some distance in the bushes, but as the night was warm and this locality much frequented by porcupines it might not be the one we were looking for. After waiting some 10 minutes the bushes slowly parted, and out walked the animal in full view.

As it stood broadside and was in the act of raising a mouthful of food, I fired the flash (see page 574); and although the little circle was filled with a dazzling light, equalling that of the sun, and much more pronounced in contrast with the evening light, the animal did not even raise its head, but went on feeding. The plate-holders were reversed, the flash reloaded, and a moment later the animal was pictured when walking toward the deeper water on a half-submerged log.

This time the flash made a consider-

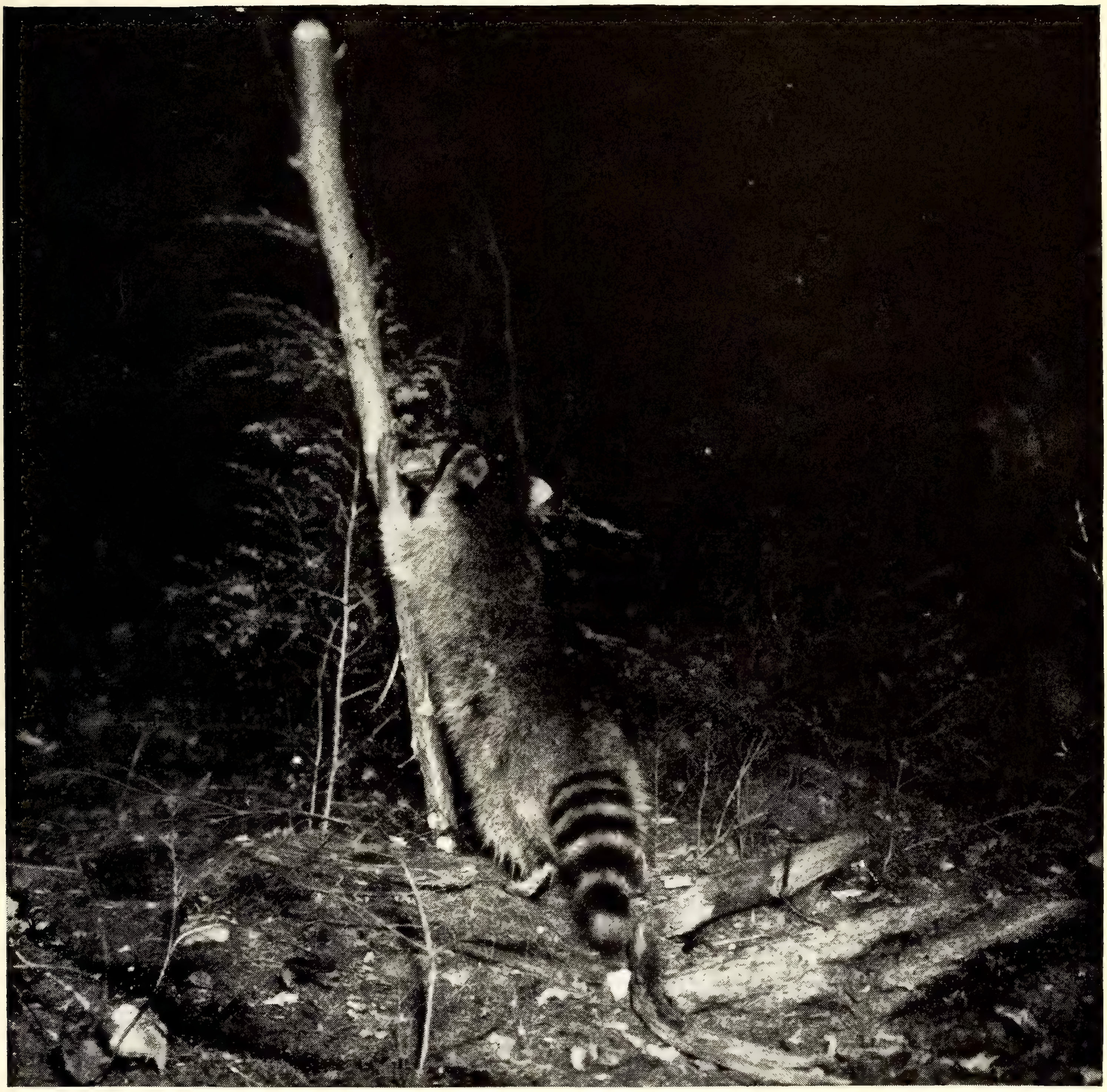


Photo by George Shiras, 3rd

A STAKE WAS DRIVEN INTO THE GROUND WITH BRUSH BEHIND IT, SO THAT THE PHOTOGRAPH WOULD SHOW THE ANIMAL FROM THE REAR: NOTE THE HANDSOME BUSHY TAIL

able report, but neither the noise nor the illumination had any effect, the animal advancing further along the log and vainly running a paw through the surface of the water in search of aquatic plants. Two more flashes were fired, and our powder became exhausted.

The mystery of this animal's indifference to light and sound and the fruitless effort to find food in deep water was not explained for several years.

Although we watched the shore on many flashlight trips after deer during this season, nothing more of this strange animal was seen.

In 1902 I had been on this lake several days, and on the evening of June 28 we became aware that the albino was still alive and still occupying its old quarters. When seen it was partly concealed behind a number of dead limbs, and only the illuminating and pene-

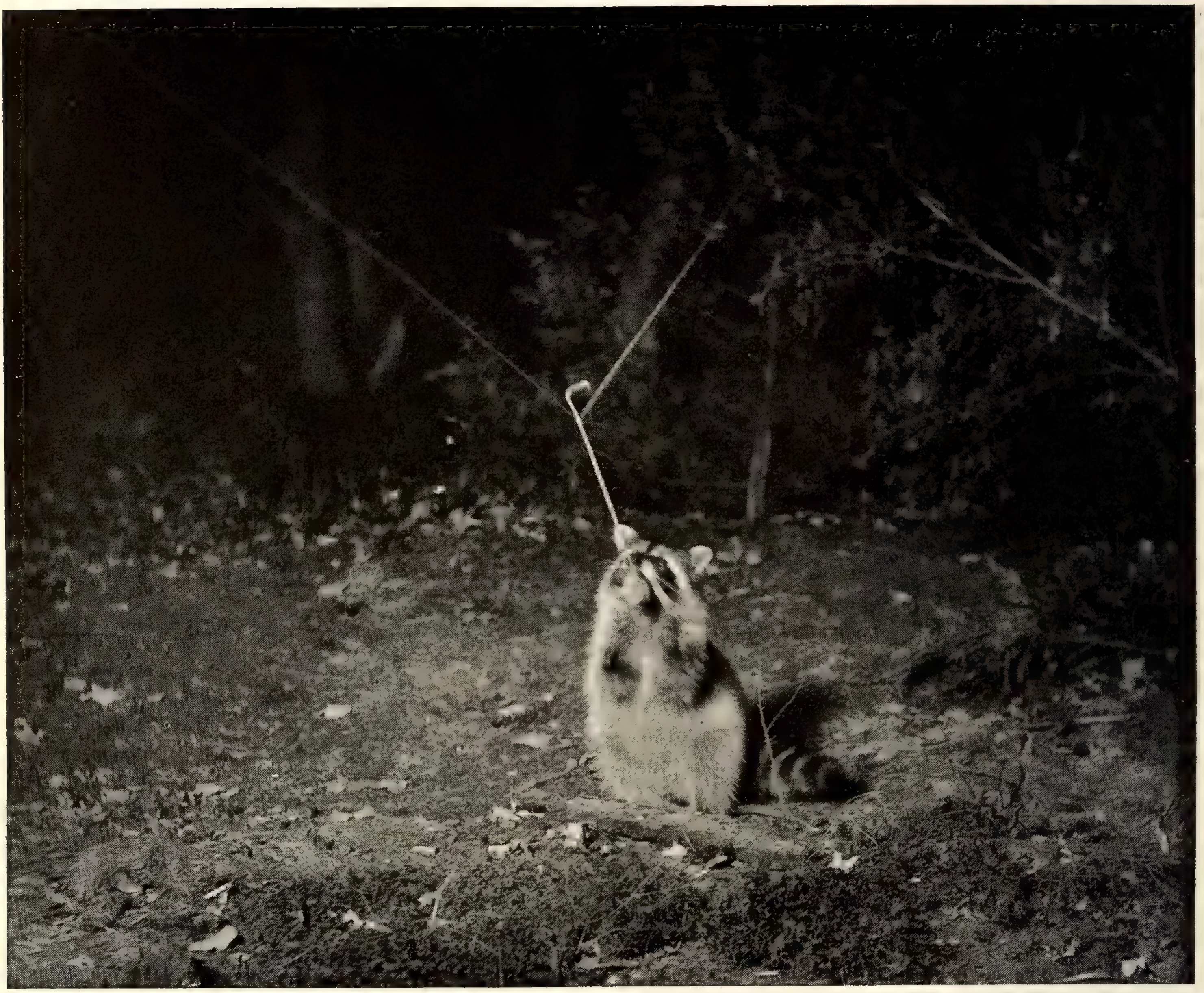


Photo by George Shiras, 3rd

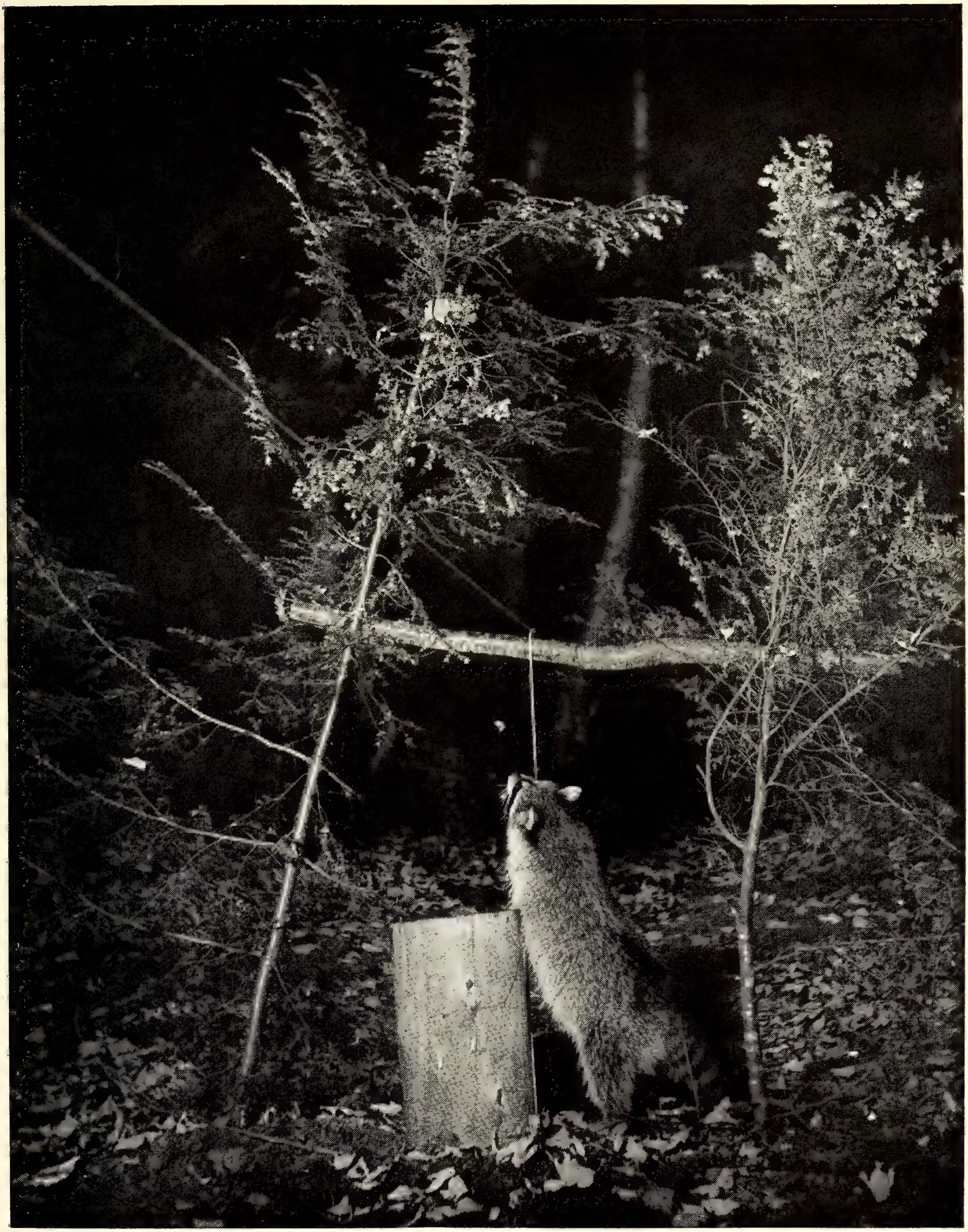
THIS PICTURE SHOWS THE ANIMAL FACING THE CAMERA AND PULLING VIGOROUSLY WHEN THE FLASH WENT OFF

trating power of the flashlight made such a picture possible. Some of the smoke of the powder drifted toward it, causing instant departure and suggesting an unusual development of scent in an animal not ordinarily dependent upon it, due, perhaps, to the impairment of the other senses (see page 575).

The several pictures of the previous year had brought out the fact that only one other albino specimen was known to exist, now preserved in a Vermont museum, and in consequence it was suggested that I capture or kill the animal in case it appeared the following season. This I was unwilling to do, and, as events proved, the wisdom of letting this freak of nature live and die a natural death was duly rewarded, for every year from 1901 to 1906 I succeeded in getting from one to ten flashlight pictures of this animal, and, aside from the pictorial value, was able to learn much about habits that were greatly modified through infirmities due to albinism.

Only once was it seen in full sunlight, and on that occasion I was not only able to substitute "her" for "it," but to determine the color of the eyes and the question of eyesight, scent, and hearing.

It was during June, 1904, that I entered the lake one morning with a party of friends, en route to Whitefish Falls, and we then observed three porcupines



THE STRING WAS CONNECTED WITH THE FLASH IN SUCH A WAY AS TO SHOW THE ANIMAL FULL LENGTH

The author varied the arrangement of the bait and flash so as to secure portraits of the coon in different positions. Photo by George Shiras, 3rd

Photo by George Shiras, 3rd

HERE AN INVISIBLE BLACK THREAD HELD BAIT IN MIDAIR

on a large log in the reeds 50 yards from shore. One was a large, dark-colored male, and the others were the white porcupine and a little black cub.

As the loaded canoe approached within 50 feet of the group the male became restless, and, scrambling along the log, fell off into the shallow water and waded ashore through the reeds. Getting a little closer, the little one first tried to huddle up to its mother, but as the latter was wandering about continually, the young one then looked at us suspiciously and finally made for the shore, taking a route somewhat to the left of the first one.

The albino, apparently not being aware of the sudden departure of her family, continued to make efforts to find some kind of an edible plant in the water, crooning softly to herself all the time. The eyes were of a bright, translucent pink, with the fire of the ruby. What had heretofore been a strong suspicion in regard to its blindness was then apparently settled, for repeatedly placing the blade of a bright-colored maple paddle in front of her, there was an unexpected collision every time, and by the way the animal seized the paddle and investigated it with teeth, nose, and feet, it was apparent that this obstacle was a great mystery.

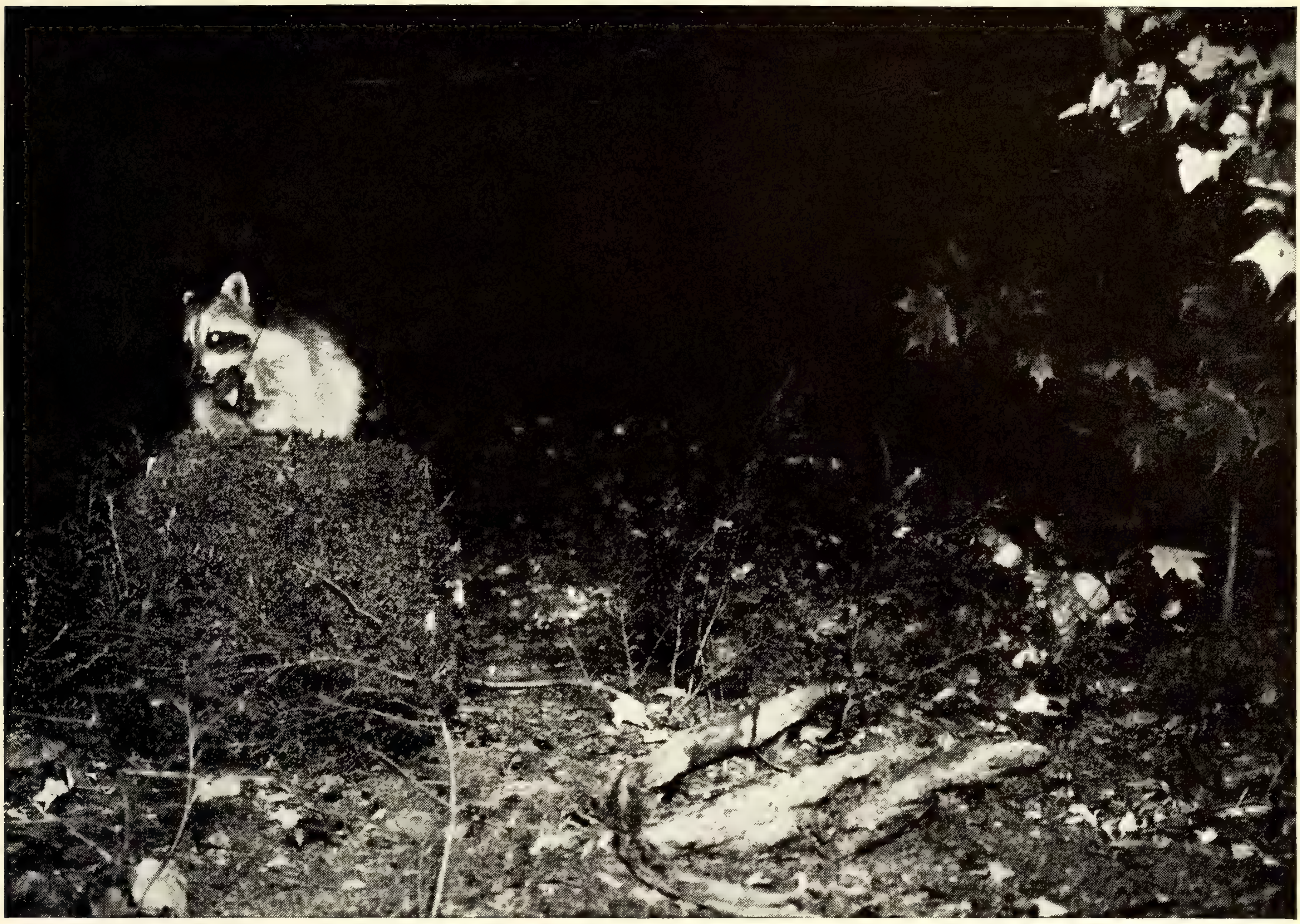


Photo by George Shiras, 3rd

THE TOP OF A MOSSY LOG WAS BAITED WITH CHEESE: NOTE REFLECTION OF EYE OF COON

Feeling sure it was similarly deaf, we all cried out in unison, but the animal showed not the slightest heed. Finally pushing around to the windward, the porcupine showed instant alarm when the scent reached it, and prepared to go ashore.

When off the log she circled a few yards and finally took the same course pursued by her young; of this we were certain, as she climbed over the same log upon which the young porcupine entered the forest. Several nights later the camera pictured the white mother and her little black cub astride the same log, feeding on the damp, green moss at the edge of the water (see page 578).

During the six years that this animal was under frequent observation, it never, when alone, departed from the trail along the shore or returned other than by the well-worn path to its cave. Often we were on the lake awaiting its appearance, and invariably the animal came down to the bank at the same spot, usually between the hours of 7 and 8, and, after going south for a distance of about 75 yards, it returned for the remainder of the night to a narrow crevice in a big glacial rock, located a short distance behind the path leading to the water. It may be worthy of note that the wind was south every evening it appeared, and that consequently the animal always fed down wind—further evidence, perhaps, of the dependence placed upon the nose.

The several pictures tell their own story of these evening journeys, year after year, and of its cavernous home, which later, enshrouded in the immaculate snows of Lake Superior, became its tomb, in the winter of 1907.

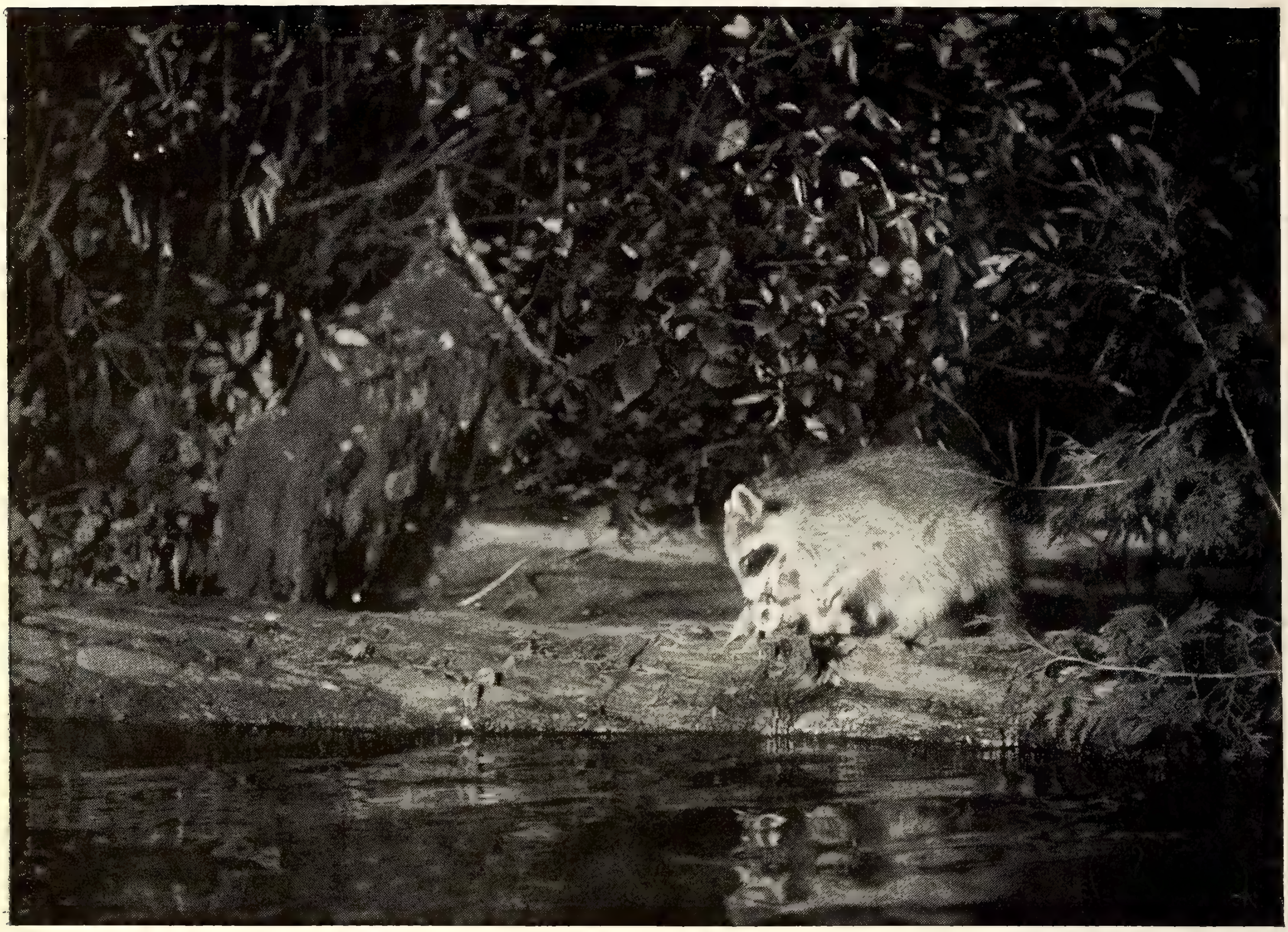


Photo by George Shiras, 3rd

BY STREWING CHEESE FROM THE BANK ALONG THE SURFACE OF A LOG EXTENDING INTO THE LAKE THE ANIMAL WAS TAKEN IN THE POSITION SHOWN

STORY OF AN ITINERANT COON

The following extracts from a camp diary chronicle the events of one week on White Fish Lake and preface the story of a wandering coon:

"*August 21, 1903.*—After arising and before I had breakfast, Jim came from the barn with the announcement that all the young chickens had been killed during the night—some 60 in number. The various broods were more than half grown, and for several weeks had been consorting together at night by huddling in a narrow recess between two adjoining buildings. Jim having noticed that they were not about the yard in the morning, found them all dead in the narrow space referred to. Pulling a few bodies out with the aid of a rake, he found the throats had been cut by some predaceous animal, and he proceeded to investigate.

"I recalled a somewhat similar tragedy several years before, when a large number had been killed by a half-grown skunk. Jim, however, said it was a coon in the present case, and the statement excited some derision on my part, since this animal was utterly unknown in the region. Jim's conclusion, it appeared, was not a matter of guesswork, for he found that the bodies of a number of chickens had been torn open and the liver eaten—a coon trick, according to Jim.

"He further found that the animal had entered the poultry yard by removing some heavy flat stones from beneath the wire fence—a thing that neither a fox, skunk, nor weasel was capable of doing—while the concluding evidence be-

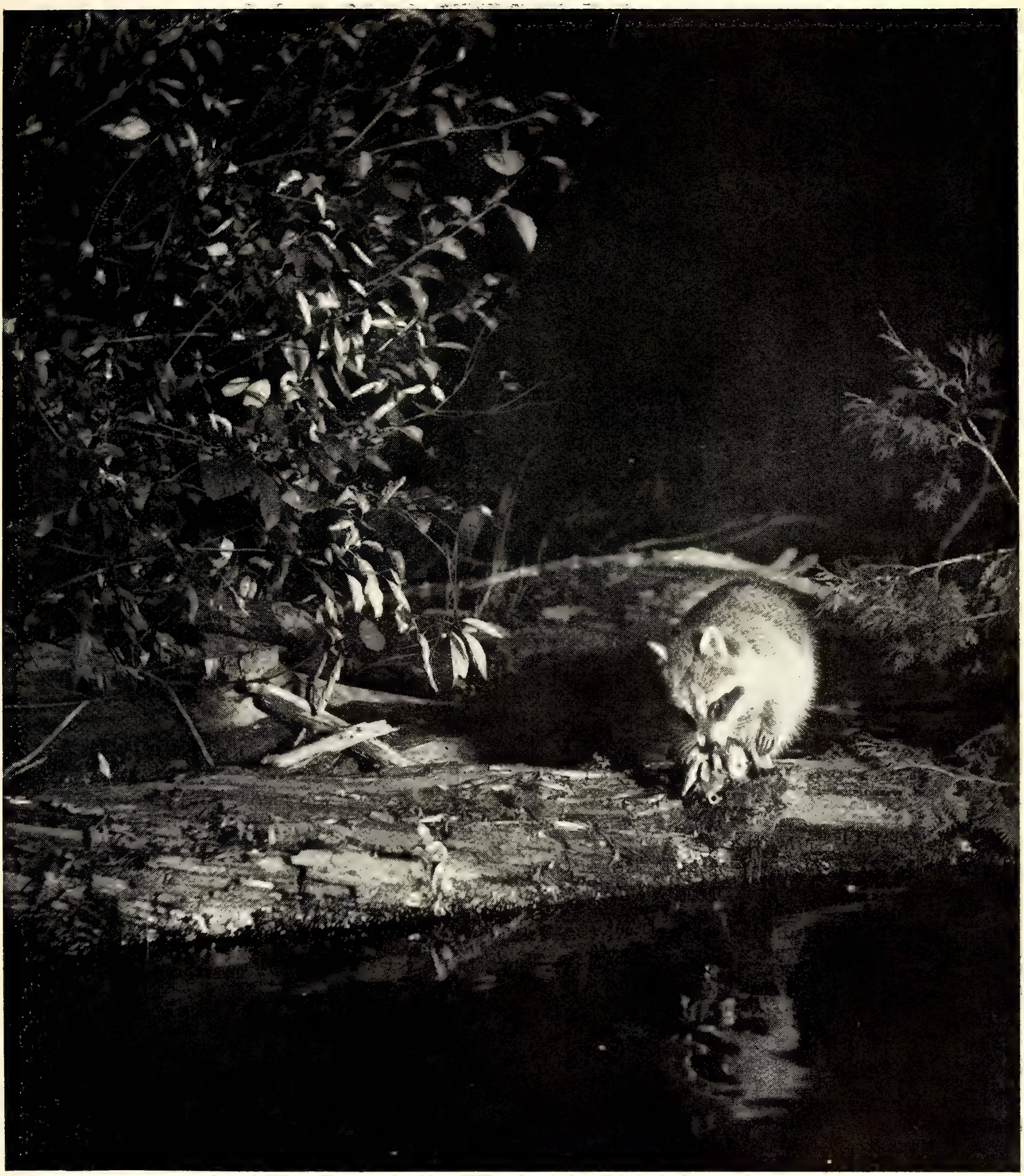


Photo by George Shiras, 3rd

A FRONT VIEW OF THE COON, OBTAINED BY THE SAME METHOD AS EMPLOYED TO SECURE THE PRECEDING PICTURE

came invincible when he pointed out, in the moist ground around the water-trough, an imprint that in miniature resembled the track of a bear or that of a child; so this plantigrade track must have been made by a coon. This was a most interesting discovery, especially as we knew the animal would return again that night.

"The damage having been done, I requested Jim not to set the steel trap, but to leave some of the dead chickens out-

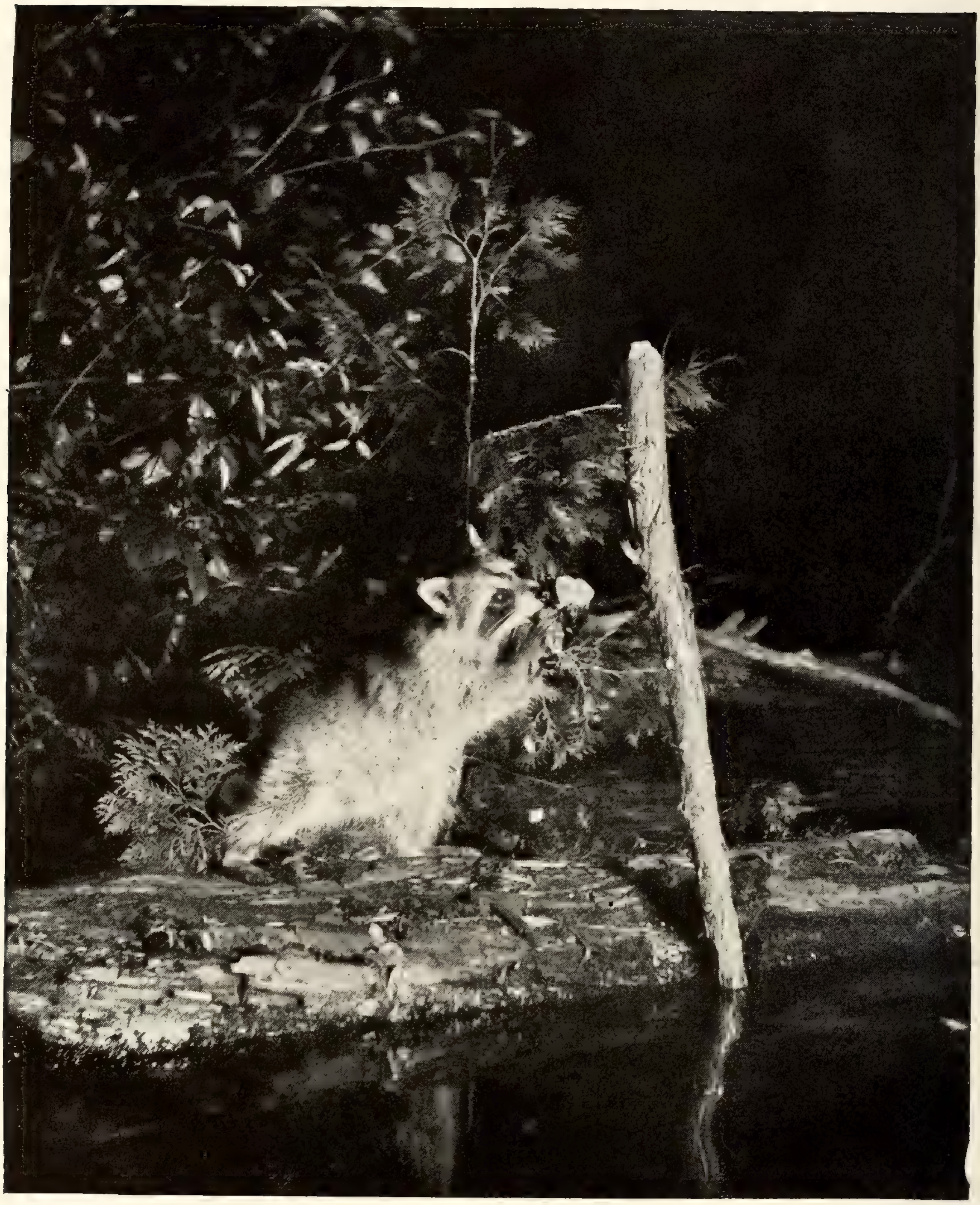


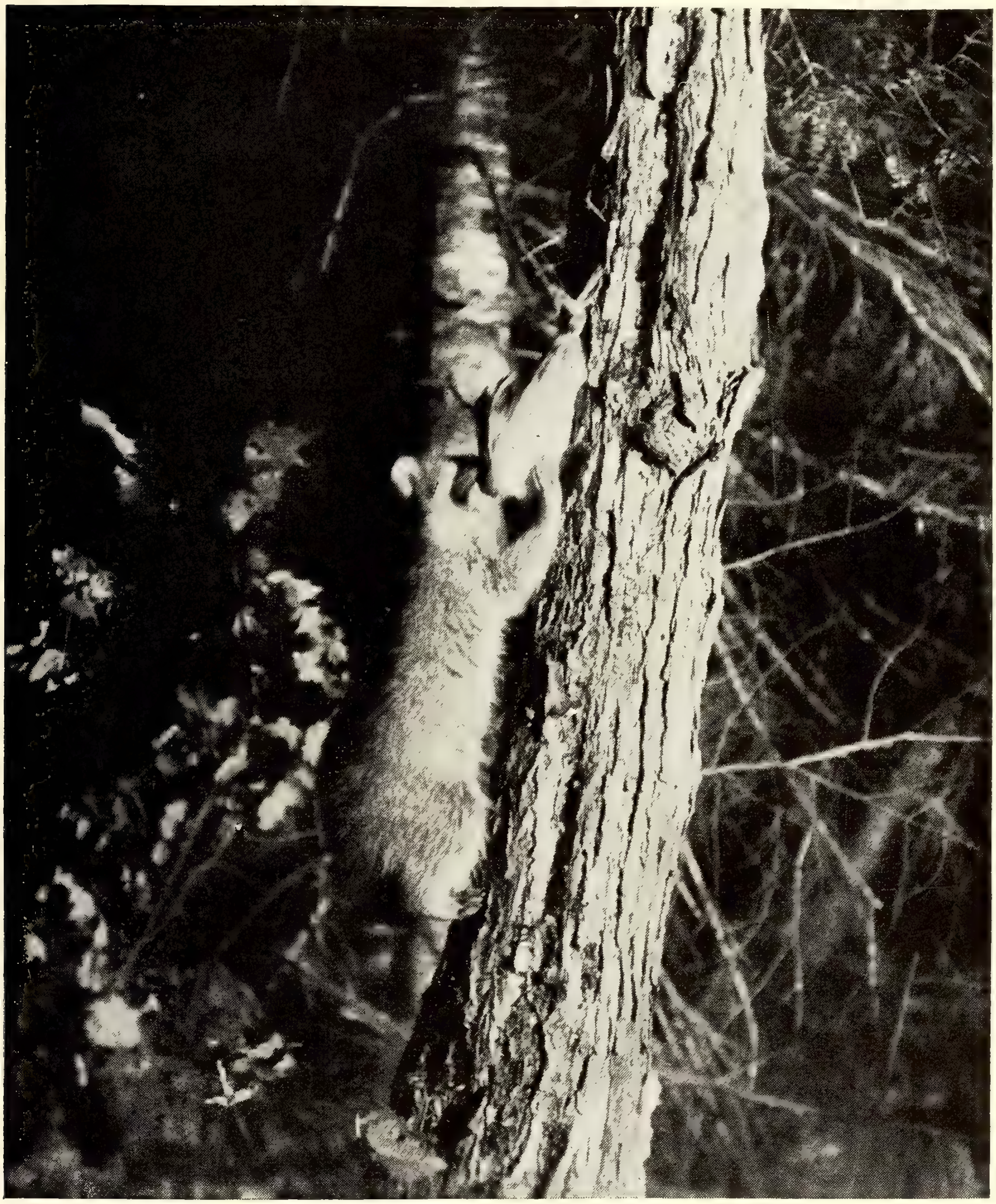
Photo by George Shiras, 3rd

THIS NIGHT A STAKE WAS DRIVEN INTO THE WATER WITH BAIT SO ARRANGED THAT THE ANIMAL HAD TO STAND UP AND REACH FORWARD WHEN PULLING

side the fence for the animal's temporary entertainment, that I might in a night or two set out a flashlight after returning from a several days' trip to the house-boat, where I was about to try for a shot at a pack of timber wolves.

"On the way up the river that afternoon I noticed the ripples caused by a swimming animal under the alders, and supposed it to be a muskrat until the gray body of a coon suddenly crossed a foot or two in front of the canoe. And although I had a chance to disable it with a blow from a hard-wood paddle, I let it go for the same reason that withheld the setting of the steel trap.

"Returning to the house-boat after dark without having gotten a shot at a wolf, though one howled dismally in a dense covert not 50 yards from the canoe, we were surprised as well as gratified at seeing a coon sitting on the gangplank of the house-boat. We thereupon set up a couple of cameras with the flashlight machine a little above them, and ran a string 10 feet to an eye-screw at the base of a hemlock, with cheese and fish fastened to the end of it.



This was the last picture taken, and the coon was induced to climb 15 feet up a maple by baiting a detached string every 6 inches. At the top he was rewarded with a fat duck, connected by a string with the flash. However, the flash so frightened him that he fled without the duck. Photo by George Shiras, 3rd.

While at work I heard a slight movement in the dry leaves beyond, and turning the jack-light in that direction, saw only the two glowing eyes of the hungry visitor. And here it may be remarked, parenthetically, that while the eyes of all predaceous animals possess a wonderful luminosity when reflecting back the rays of a light at night, the porcupine and all other rodents, with one or two exceptions, do not glow at all.

"Returning to the house-boat and putting out the light, only a few minutes elapsed before the brilliant glare of the exploding flashlight was seen through the open windows. Quick as we were, the coon had disappeared on discovering what terrible things resulted from simply pulling at a little piece of cheese on the end of a string.

"*August 22, 1903.*—Went down the river to camp in order to develop last night's flashlight of the coon, and found, on developing the negative, he preferred the cheese to the fish (see page 584). The dead chickens left beyond the fence at camp were undisturbed—fairly conclusive evidence that our visitor at the house-boat was the one guilty of the former depredation. Getting a good

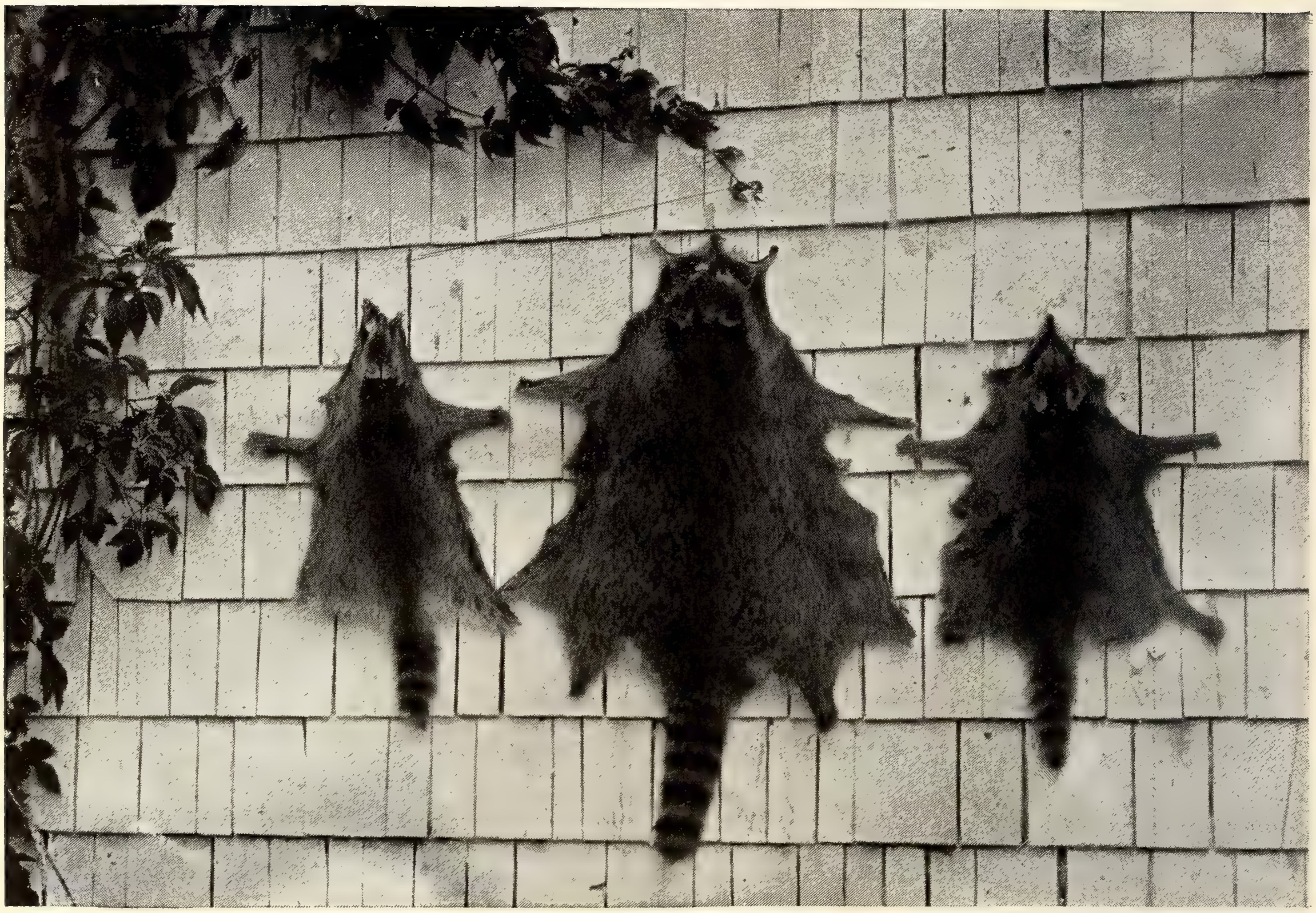


Photo by George Shiras, 3rd

"THE END OF MOST WILD ANIMALS IS A TRAGEDY" (SEE TEXT BELOW)

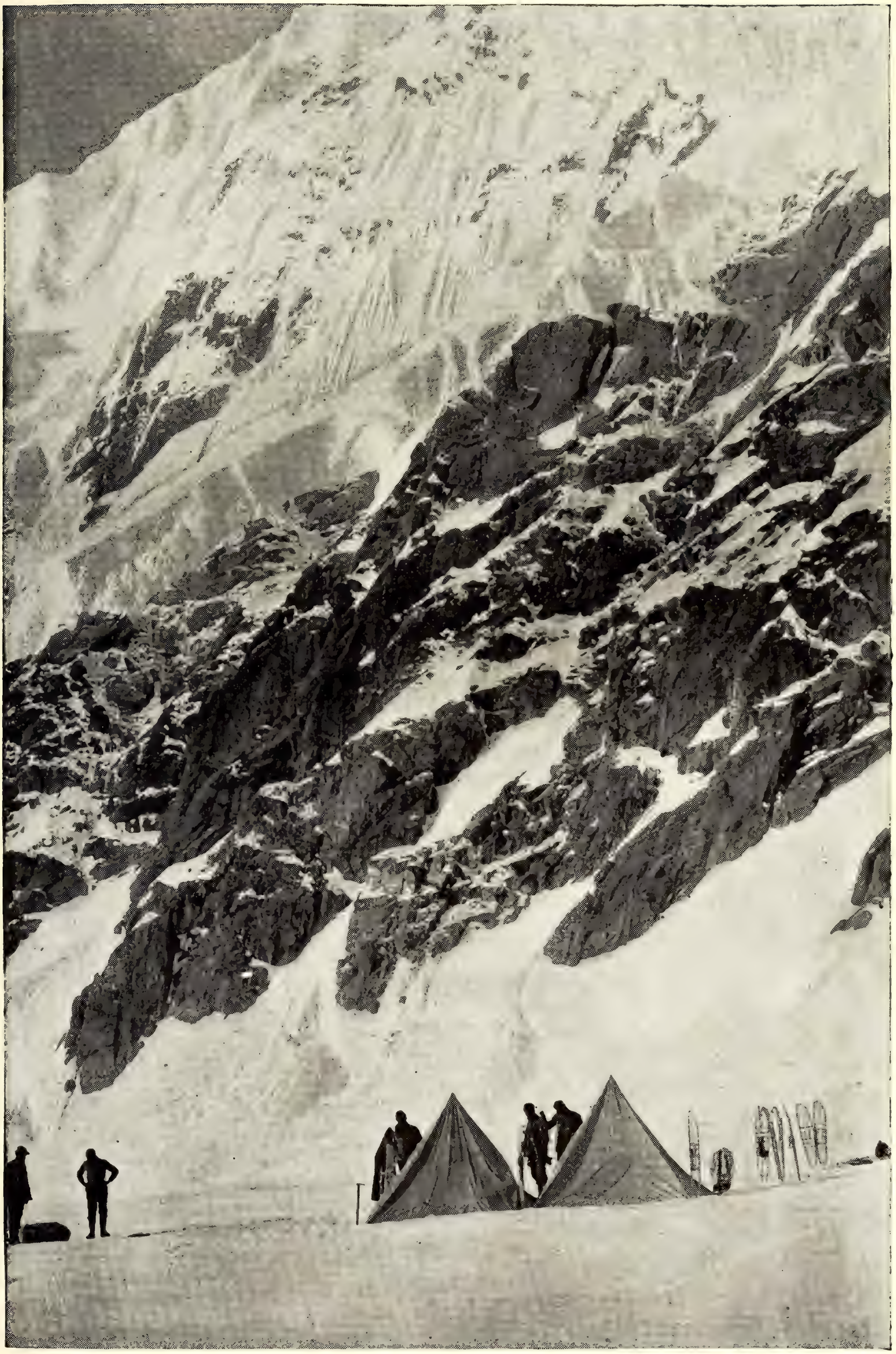
supply of flashlight powder and plates, we returned in the evening to the lake, determined to give the coon plenty of extra bait with the hope that it might be induced to take a number of its own pictures during the night. In this we were successful, as the flash was fired first about 9 o'clock, then two hours later, and finally just before daybreak.

"While the coon is cunning, he is not only very inquisitive, but extremely daring when after a choice meal. Possibly a million coons are trapped every year, and yet few are shot except at night, with the aid of dogs. The coon is almost wholly nocturnal, for I have been on islands in the Gulf of Mexico which harbored untold thousands, and yet, although they were not molested, I seldom saw one in daytime."

It would take many pages to describe the nightly bombardments of the two weeks that followed. Finding that pictures taken in the same spot meant many duplications in coon portraiture, we tried each night to select some new place, and, by arranging the bait differently, thereby obtain a greater variety in position and surroundings.

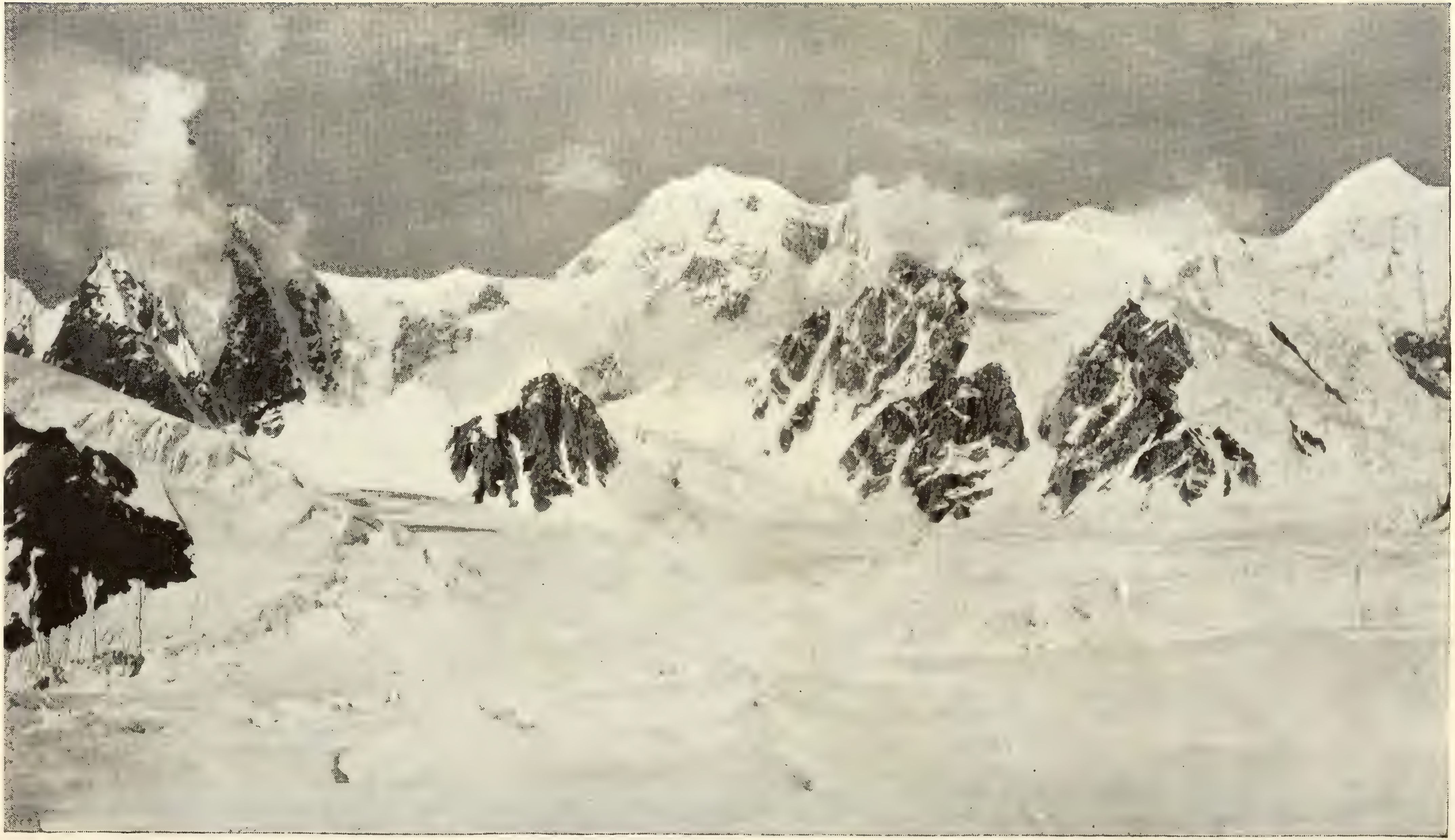
The day before departing on a camping trip to Canada, my guide and I endeavored to arrange for a concluding picture that would be in striking contrast to all the others. A thread 15 feet long was baited every half foot with cheese, and one end was suspended from the upper half of a maple tree. A fish-duck, shot for the purpose, was made the final goal at the end of the string. The result of this experiment is shown in the final picture of the coon (see page 595).

A month later I returned to camp, and as Jim, the hostler, came out to unharness the team, I asked him with some curiosity whether "my coon was still about." "Yes," replied Jim, much to my pleasure; "it is still here, and has two young ones. And they are not far away, either," he remarked, after some hesitation, pointing towards the end of the barn, where the trio of pelts were drying in the sun.



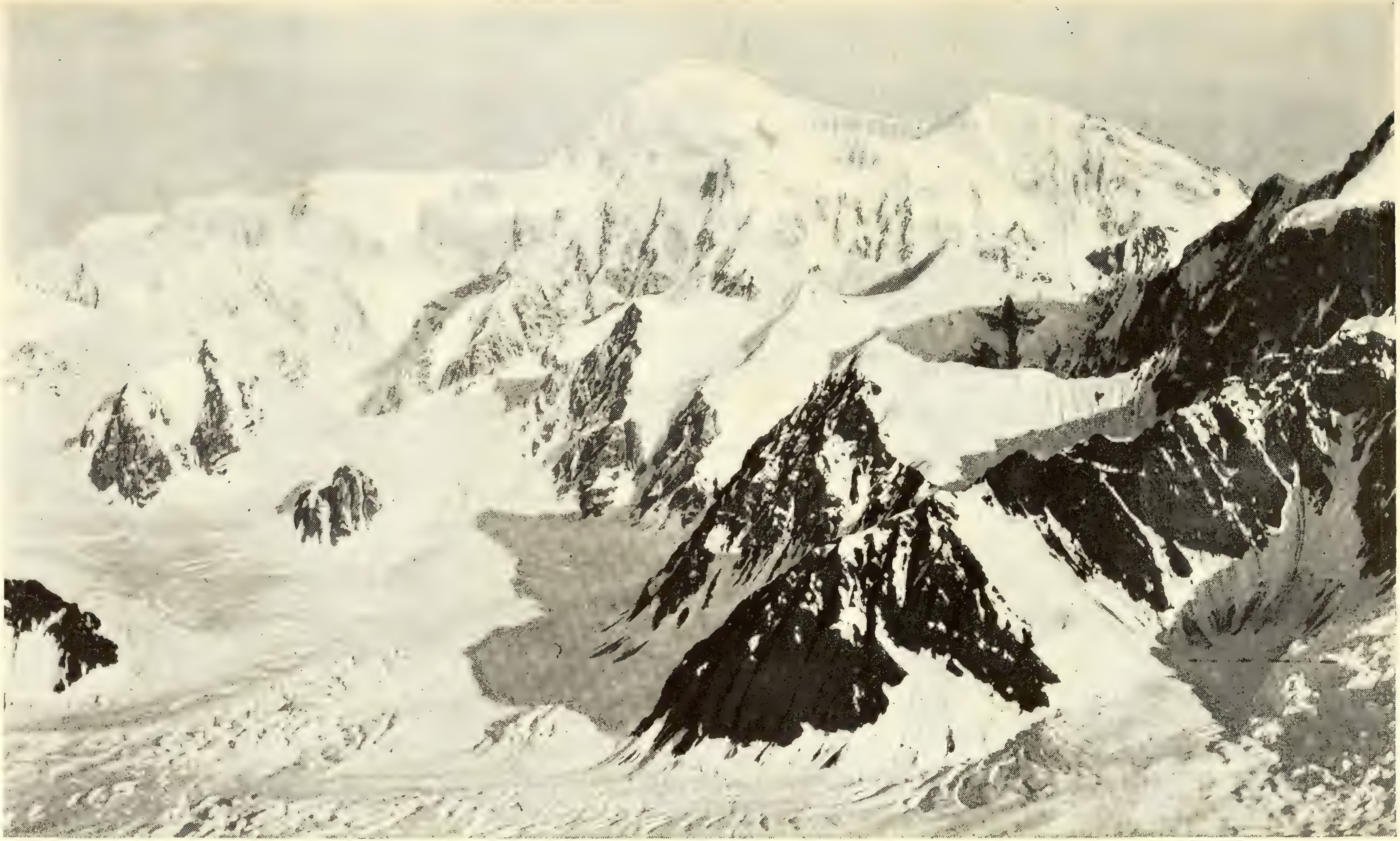
CAMP UNDER THE CLIFFS OF MOUNT HUNTINGTON

The cliffs are still 2 miles away. Mount McKinley's neighboring peaks are splendid mountains, though dwarfed by McKinley's grandeur. Photo from Waldemar H. Grassi



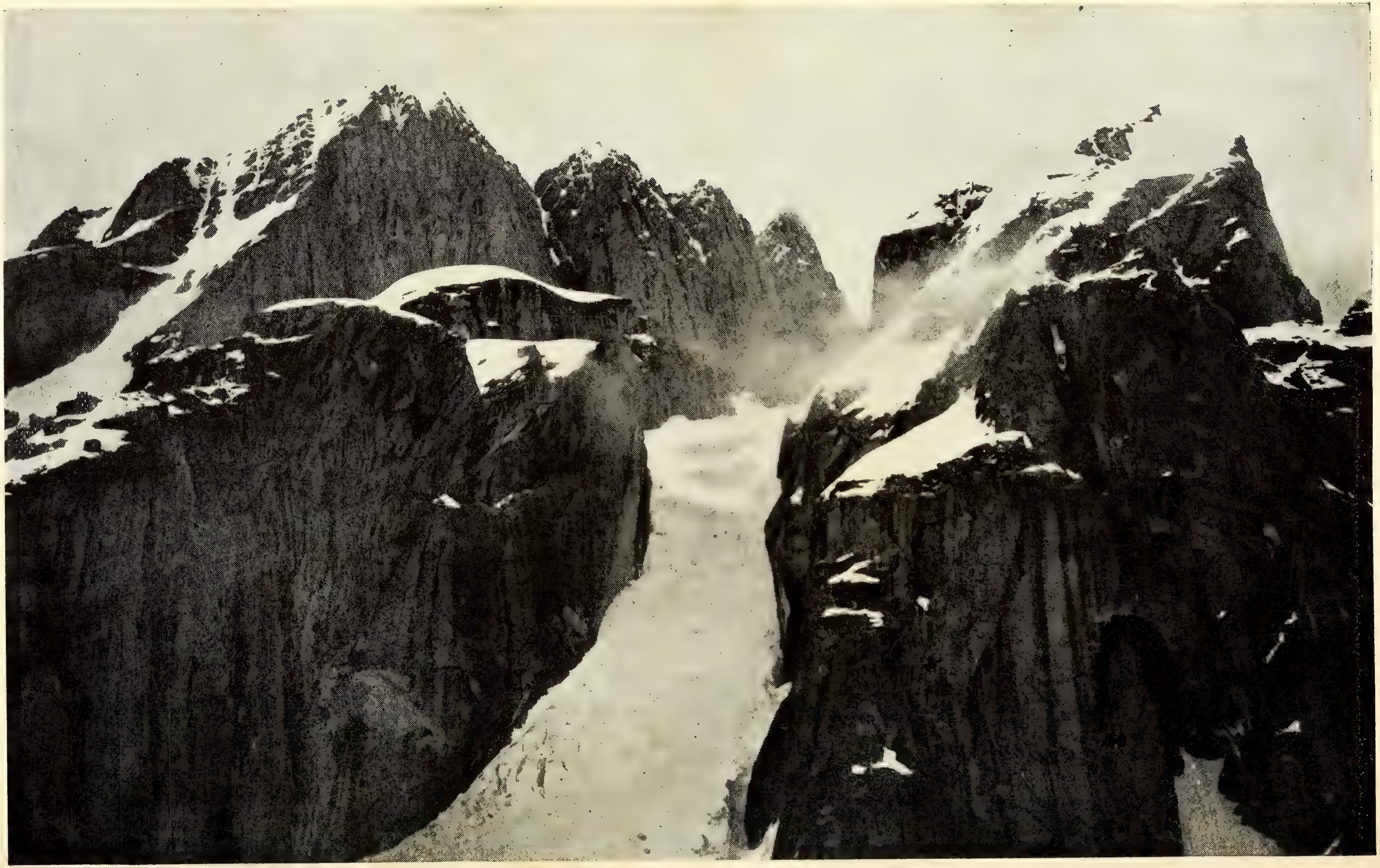
VIEW OF MOUNT MCKINLEY FROM THE EAST, 7 MILES DISTANT, AT AN ELEVATION OF 7,000 FEET

Mount McKinley lifts its head 20,300 feet over the wastes of west Alaska. It is the highest mountain of North America, and has the longest snow and ice slope of any of the world's great mountains. Mount McKinley demands about 18,000 to 19,000 feet of snow and ice-work, while Mount Everest, in the Himalayas, the world's highest peak, has a perpetual snow-line of between 17,000 and 18,000 feet, leaving only 11,000 to 12,000 feet of snow. Yaks can even be taken to over 20,000 feet in the trans-Himalayas. Photo by Waldemar H. Grassi.



VIEW OF MOUNT MCKINLEY FROM THE TOP OF "EXPLORERS' PEAK," 8 MILES DISTANT

This photograph, taken from an elevation of 9,000 feet, brings out the mountain's great size. The Parker-Browne Expedition to Mount McKinley spent fifty nights continuously on the ice, and experienced difficulties as great in attaining an elevation of 10,300 feet as any to be encountered in reaching an altitude of 20,000 feet in the Himalayas. "Mount Aconcagua in the Andes was ascended to its summit—23,080 feet—without putting a foot on snow, while we spent fifty nights and days on the ice in reaching an altitude less than half as high." Photo by Waldemar H. Grassi.



A HANGING GLACIER ALONG RUTH GLACIER, WHICH WINDS ITS WAY NORTHWARD TO THE GREAT AMPHITHEATER BASIN AT THE SOUTHERN BASE OF MOUNT MCKINLEY

Weather conditions in Alaska are sub-arctic, and the excessive glaciation has digged out tremendously steep amphitheaters with precipitous cliffs. The glaciers pouring into these amphitheaters are all "hanging" and bristling with seracs. The attempts to scale Mount McKinley, all of which have thus far proved failures, show that the only method of ascent is from the northern side, according to the

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